



PROJECT MANUAL

CONSTRUCTION DOCUMENTS

University of North Carolina Wilmington Film Studies Building

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PM #6034

SCO #19-20473-01A



ARCHITECTURE
PLANNING

September 23, 2019

BMG Project #2018070.01



NEW CONSTRUCTION OF UNCW FILM STUDIES

601 S. COLLEGE RD., WILMINGTON, NC 28403
SCO ID# 19-20473-01a; PM# 6034

Civil Engineer

The John R. McAdams Company, Inc.

License No.
2905 Meridian Parkway
Durham, NC 22713
(919) 361-5000



Electrical Engineer

SUD Associates, P.A.

License No. 48024
1813 Chapel Hill Road
Durham, NC 27707
(919) 493-5277



Plumbing / Mechanical Engineer

SUD Associates, P.A.

License No. 48024
1813 Chapel Hill Road
Durham, NC 27707
(919) 493-5277



Structural Engineer

Woods Engineering, P.A.

License No. 19475
254 N. Front Street, Suite 201
Wilmington, NC 28401
(910) 343-8007



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UNIVERSITY OF NORTH CAROLINA WILMINGTON

NOTICE TO BIDDERS

Sealed proposals will be received by the University of North Carolina at Wilmington in Wilmington, North Carolina, Project Management Department, in the Facilities Administration Building, Conference Room #1, up to 1:30 PM on Wednesday, October 16, 2019, and immediately thereafter publicly opened and read for the furnishing of labor, material and equipment entering into the construction of: **Film Studies Building**

Work Summary

New Film Studies Building: Site improvements and building construction of a 12,871 square foot facility. Construction includes concrete footings, concrete slab on grade, pre-engineered metal building frame, exterior metal siding and standing seam roofing, aluminum storefronts, hollow metal windows, wood and metal doors, sectional overhead door, interior metal stud partitions, interior finishes, plumbing, lighting, electrical and mechanical components. Special features include sound rated partitions and door assemblies, fire rated partitions, ADA lift and sloped interior floor. Site work includes excavation, extension and installation of utilities, earthwork, vehicular and pedestrian pavements, drainage, grading, storm water control, irrigation and landscaping.

Bids will be received for "single prime contract" by Contractors with appropriate license(s) and/or registration. All proposals shall be lump sum.

Pre-Bid Meeting

A non-mandatory Pre-Bid Conference was held on Wednesday, August 21, 2019, in the UNCW Project Management Department, in the Facilities Administration Building. Minutes from this conference are available upon request.

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. SCHLAGE, locksets
- B. VON DUPRIN, door hardware and latches
- C. LCN, door closers, operators and magnetic hold-open
- D. IVES, hinges
- E. STEELCRAFT, hollow metal doors and frames
- F. MARSHFIELD, flush wood doors
- G. INPRO ENDURANT, plastic toilet compartments

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

Requests for information (RFI) will be accepted during bidding until Wednesday, October 9, 2019 at 4:00 PM. All RFI's must be submitted to the Architect and UNCW Project Manager in writing via e-mail.

Architect: Becker Morgan Group, Inc.; L. Mark Loudermilk, AIA, mloudermilk@beckermorgan.com
UNCW Project Manager: Lisa Seifert, seifertl@uncw.edu

The UNCW Facilities Project # 6034 shall be clearly indicated on the outside of the envelope.

Complete plans, specifications and contract documents will be open for inspection in the offices of UNCW Facilities Administration, 5150 Lionfish Drive, Wilmington, NC; the printer (Copycat Print Shop, 4107 Oleander Drive, Unit J, Wilmington, NC) and in the plan rooms of the Associated General Contractors, Carolinas Branch, in the local North Carolina offices of McGraw-Hill Dodge Corporation, and in the Eastern Regional Office of Reed Construction Data in Norcross, GA and in Minority Plan Rooms in:

UNIVERSITY OF NORTH CAROLINA WILMINGTON

NOTICE TO BIDDERS

1. Hispanic Contractors Association of the Carolinas (HCAC), through Duncan-Parnell, Inc., 4275 Regency Drive, Greensboro, NC, 336-855-1211
2. East Coast Digital – Minority Plan Room Provider 1982 Wesley Lane, Greenville, NC 27858, 252-758-1616

or may be obtained by those qualified as prime bidders, from the printer: Copycat Print Shop, 4107 Oleander Drive, Unit J, Wilmington, NC 28403, 910-799-1500,

<https://www.beckermorganplanroom.com/jobs/87/details/university-of-north-carolina-wilmington-film-studies-building>

NOTE: The bidder shall include with the bid proposal the form *Identification of Minority Business Participation* identifying the minority business participation it will use on the project and shall include either *Affidavit A* or *Affidavit B* as applicable. Forms and instructions are included within the Form of Proposal 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 and/or registration as required under the state laws governing their respective trades associated within this project.

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 Contractors.

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

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

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

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

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

Designer:
Becker Morgan Group, Inc.
3333 Jaeckle Drive, Suite 120
Wilmington, NC 28403
910.341.7600

Owner:
State of North Carolina Acting through the
Board of Trustees of the Endowment Fund of the
University of North Carolina at Wilmington
601 S. College Rd
Wilmington, NC 28403

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

STANDARD FORM FOR CONSTRUCTION PROJECTS

**UNIVERSITY OF NORTH CAROLINA
GENERAL ADMINISTRATION**

Fifth Edition – January 2015

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 bidders 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 with appropriate attachments to 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 the 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 owner.

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.
- 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 information may 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 of completed work. 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 University of North Carolina, and is distributed by, through and at the discretion of UNC - General Administration, Chapel Hill, 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 drawings and specifications, including all bulletins, addenda or other modifications of the drawings and specifications incorporated into the documents prior to their execution; the proposal; the contract; the performance bond; the payment bond; insurance certificates; the approval of the university attorney; 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 expeditor**, 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 and designer and approved by the owner 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, and owner .
- 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 of 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 cannot 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 the approval of the 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 with 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 North Carolina Building Codes.
- aa. **Beneficial Occupancy** is requested by the owner and is occupancy or partial occupancy of the building or project after all life safety items have been completed as determined by the State Construction Office. Life safety items include but are not limited to fire alarm, sprinkler, egress and exit lighting, fire rated walls, egress paths and security.
- bb. **Final Acceptance** is the date on which the State Construction Office approves the project as complying with the North Carolina Building Codes and the owner accepts the construction as totally complete. This includes certification by the Designer that all punch list items are completed.

ARTICLE 2 - INTENT AND EXECUTION OF DOCUMENTS

- a. The drawings and specifications are complementary, one to the other. That which is shown on the drawings or called for in the specifications shall be as binding as if it were both called for and shown. The intent of the drawings and specifications is to establish the scope of all labor, materials, transportation, equipment, and any and all other things necessary to provide a 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 the 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 two (2) copies (one for the Designer, one for the owner) 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, the 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 State of North Carolina. 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 approve.

- e. The designer is the judge of equality for proposed substitution of products, materials or equipment.
- f. 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 by 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.
- c. 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.
- d. Projects involving local funding may be subject also to county and municipal building codes and inspection by local authorities. The Contractor shall pay the cost of these permits and inspections as noted in the specifications.

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 member 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 correction of 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 correction of damage caused by 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 the designer, special inspector and/or State Construction Office prior to being covered by the contractor. Contractor shall give a minimum notice of two weeks unless otherwise agreed to by all parties. If inspection fails, after the first re-inspection all costs associated with additional inspections 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 and 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 project conference. The owner will determine the 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 expeditor on projects involving two or more prime contracts. The project expeditor 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 punch list(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 punch list(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.

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 biweekly 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 expeditor 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 expeditor to immediately notify the contractor(s) responsible for such delay, the designer, the owner and other prime contractors. The designer shall determine the contractor(s) who caused the delays 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 expeditor 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 time commitment of the project superintendent to the project shall be such as to insure satisfactory construction progress & coordination as determined by the project designer and owner and may be as stipulated in the Supplementary General Conditions.

ARTICLE 15 - SEPARATE CONTRACTS AND CONTRACTOR RELATIONSHIPS

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

ARTICLE 17 - CONTRACTOR AND SUBCONTRACTOR RELATIONSHIPS

The contractor agrees that the terms of these contract documents shall apply equally to each subcontractor as to the contractor, and the contractor agrees to take such action as may be necessary to bind each subcontractor to these terms. The contractor further agrees to conform to the Code of Ethical Conduct as adopted by the Associated General Contractors of America,

Inc., with respect to contractor-subcontractor relationships, and that payments to subcontractors shall be made in accordance with the provisions of G.S. 143-134.1 titled "Interest on final payments due to prime contractors: payments to subcontractors."

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

A field order, transmitted by fax 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 below under either c.1 or 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 and owner, the value of the change shall be computed by application of unit prices based on quantities, estimated or actual as agreed on 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 c.2. above, the allowances for overhead and profit combined shall be as follows: all contractors (the single contracting entity (prime), his subcontractors (first tier), or their subcontractors (second tier, third tier, etc.) shall be allowed a maximum of ten percent (10%) on work they each self-perform; the prime contractor shall be allowed a maximum of five percent (5%) on contracted work of his first tier subcontractor; first tier, second tier, third tier, etc. subcontractors shall be allowed a maximum of two and one-half percent (2.5%) on the contracted work of their subcontractors. Under c.1. no additional allowances shall be made for overhead and profit. In the case of deductible change orders, under c.2. and 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; vehicles; 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 a lack of proper submittal by the contractor of all required supporting data shall not constitute grounds for a time extension or basis for 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 approval. The owner shall approve and execute the change order within seven (7) days of receipt. 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 extra work included, omitted or substituted. It shall show on its face the adjustment in time for completion of the project as a result of the change in the work.
- j. If, during the progress of the work, the owner requests a change order and the contractor's terms are unacceptable, the owner 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 the 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 c. above. Without prejudice, nothing in this paragraph shall preclude the owner from performing or having 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. 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 by the contractor that complies with the requirements of (a) above be denied by the designer or owner, and cannot be resolved by a representative of The University of North Carolina General Administration, the contractor may request a mediation in connection with G.S. 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 claims as a result of mediation, the contractor may pursue his claim in accordance with the provisions of G.S. 143-135.3 and the following:
 1. A contractor who has not completed a contract with an institution of The University of North Carolina and who has not received the amount he claims is due under the contract may submit a verified written claim to the Associate Vice President for Finance & University Property Officer of The University of North Carolina General Administration for the amount the contractor claims is due. If the claim remains unresolved after review by the Associate Vice President for Finance, the contractor may submit the 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 an institution of University of North Carolina 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 Associate Vice President for Finance & University Property Officer of The University of North Carolina General Administration for the amount the contractor claims is due. If the claim remains unresolved after review by the Associate Vice President for Finance, the contractor may submit the 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 Associate Vice President'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 owner, 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, fires, 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 delay. 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 with copies to the owner within twenty (20) days following cause of delay. In case of continuing cause for delay, the contractor shall notify the designer in writing with copies to the owner of the delay within twenty (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 completion of the project.
- b. Should the owner request a utilization of the building or portion thereof, the designer shall perform a designer final inspection of the 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, 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 owner and State Construction Office, in such areas the following will be established:
 - 1. The beginning of guarantees and warranties period for the equipment necessary to provide support in the area.

2. The owner assumes all responsibilities for utility costs for the entire building
 3. Contractor will obtain consent of surety.
 4. 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 owner and SCO final inspection. Prior to owner & 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, the owner and State Construction Office representatives shall make one of the following determinations:
 1. That the project is completed and accepted.
 2. That the project will be accepted subject to 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.
 3. 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.
- e. 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.
- f. Prior to issuance of final acceptance date, the contractor shall have his authorized representatives visit the project and give full instructions to the owner's designated personnel regarding operating, maintenance, care, and adjustment of all equipment and special construction elements. In addition, the contractor shall provide 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. The contractor shall correct or make good any defects due thereto and repair any damage resulting therefrom which may appear during the guarantee period following final acceptance of the work except as stated otherwise under Article 42, Guarantee. The owner will report any defects as they may appear to the contractor and establish a time limit for completion of corrections by the contractor. The owner will be the judge as to the responsibility for correction of defects.

ARTICLE 28 - OWNER'S RIGHT TO DO WORK

If, during the progress of the work or during the period of guarantee, the contractor fails to prosecute the work properly or to perform any provision of the contract, the owner, after 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 ten (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 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 and the owner and located as close to the site as possible. The warehouse selected must be approved by the contractor's bonding and insurance companies; the material to be paid for shall be assigned to the owner and shall be inspected by the designer. Upon approval by the designer and owner of the storage facilities and materials and equipment, payment therefore will be certified. Responsibility for such stored materials and equipment shall remain with the contractor. Such stored materials and equipment shall not be moved except for transportation to the project site. Under certain conditions, the designer may approve storage of materials at the point of manufacture, which conditions shall be approved by the designer and the owner prior to approval for the storage and shall include an agreement by the storing party which unconditionally gives the State absolute right to possession of the materials at any time. Bond, security and insurance protection shall continue to be the responsibility of the contractor(s).
- e. On projects requiring a Critical Path Method (CPM) construction schedule, the project expeditor will submit with each monthly pay application to the designer a current CPM

schedule in a computerized precedence network format on a compact disc. The schedule will include all construction activities to be accomplished during the project to be properly sequenced and coordinated with elements of the work. The schedule shall be assembled from input presented and mutually coordinated by all the contractors (and/or subcontractors) and integrated into a single, overall schedule. The project expediter will show all the scheduled work activities, including their subcontractors, and the sequence and interdependence (predecessors and successors) of the activities. The schedule shall show the total project duration including milestone dates. The critical path shall be clearly indicated. The schedule shall be in such a format that it can be read (imported) in Microsoft Project or Primavera P6. Failure to submit the construction schedule on compact disc media in an acceptable format will result in the pay application being denied.

- f. In the event of beneficial occupancy, retainage of funds due the contractor(s) may be reduced with the approval of the owner to an equitable amount to cover the list of items to be completed or corrected. Retainage may not be reduced to less than two and one-half (2 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 are 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 subcontractors 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 owner may withhold payment for the following reasons:
1. Faulty work not corrected.
 2. The unpaid balance on the contract is insufficient to complete the work in the judgment of the designer.
 3. To provide for sufficient contract balance to cover liquidated damages that will be assessed.
- b. The owner may authorize the withholding of payment for the following reasons:
1. Claims filed against the contractor or evidence that a claim will be filed.
 2. Evidence that subcontractors have not been paid.
- c. The owner may withhold all or a portion of the contractor's general conditions costs set forth in the approved schedule of values if the contractor has failed to comply with: (1) a request to access its records by the owner's internal auditors pursuant to Article 52; (2) a request for a plan of action and/or recovery schedule under Article 14j; (3) a request to provide electronic copies of contractor's baseline schedule and/or updates with all logic used to create schedules in the original format of the scheduling software; and (4) contractor's failure to have its superintendent on the project as provided in Article 14.1 and/or as stipulated in the Supplementary General Conditions.

- 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 coverage 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 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 may be 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 unless stipulated otherwise in the project specifications. The 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 unless otherwise stipulated. 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 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 General Contractor 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 the 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 acceptance of work by the State Construction Office and owner, 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 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 General Contractor 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 General Contractor 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 General Contractor 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 General Contractor's bid.
- l. The General Contractor 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 General Contractor. The General Contractor 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 General Contractor shall broom clean the building as required to minimize dust and dirt accumulation.
- b. The General Contractor 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 therefrom, and (2) is caused in whole or in part by any negligent act or omission of the contractor, the contractor's subcontractor, or the agents of either the contractor or the contractor's subcontractor. Such obligation shall not be construed to negate, abridge or otherwise reduce any other right or obligation of indemnity which would otherwise exist as to any party or person described in this article.

ARTICLE 45 - TAXES

- 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 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 contractors 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 business 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 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 General Statute 133-32, it is unlawful for any vendor or contractor (i.e. architect, bidder, contractor, construction manager, design professional, engineer, subcontractor, supplier, etc.) to make gifts or give favors to any State employee. This prohibition covers those vendors and contractors who: (1) have a contract with a government agency; or (2) have performed under such a contract during 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 General Statute 133-32.

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 employees that may have any involvement, influence, responsibilities, oversight, management and/or duties that pertain to and/or relate to the construction administration, financial administration and/or disposition of claims arising from and/or relating to the contract and/or the project.

ARTICLE 52 – AUDITING – ACCESS TO PERSONS AND RECORDS

In accordance with General Statute 147-64.7, the State Auditor shall have access to the contractor's officers, employees, agents and/or other persons in control of and/or responsible for the contractor's records that relate to this contract 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 lost 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 the owner and/or the owner's project representatives.

ARTICLE 53 – NORTH CAROLINA FALSE CLAIMS ACT

The North Carolina False Claims Act (NCFCA), General Statute 1-605 through 1-618, applies to this contract. The contractor should familiarize itself with the entire NCFCA and its applicability to any requests, demands and/or claims for payment submitted to the State through the contracting university or affiliate.

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 NCFCA may arise from, but not be 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 lost 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 for claims, and/or any other request for payment from the state through the contracting state agency, institution or university. 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 “any 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 by 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©.)

Finally, the contracting university or affiliate 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

- a. The owner may, at any time and for any reason terminate the contractor's services and work at the owner's convenience. Upon receipt of such notice, the contractor shall, unless the notice directs otherwise, immediately discontinue the work and placing orders for materials, facilities and supplies in connection with the performance of this agreement.
- b. Upon such termination, the 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 the contractor as are permitted by the prime contract and approved by the 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 the contractor prior to the date of the termination of this agreement. The contractor shall not be entitled to any claim or claim of lien against the owner for any additional compensation or damages in the event of such termination and payment.

STATE OF NORTH CAROLINA
COUNTY SALES AND USE TAX REPORT
SUMMARY TOTALS AND CERTIFICATION

CONTRACTOR: _____

Page 1 of

PROJECT: _____

FOR PERIOD: _____

	TOTAL FOR COUNTY OF:	TOTAL FOR COUNTY OF:	TOTAL FOR COUNTY OF:	TOTAL FOR COUNTY OF:	TOTAL FOR COUNTY OF:	TOTAL FOR COUNTY OF:	TOTAL ALL COUNTIES
CONTRACTOR							
SUBCONTRACTOR(S)*							
COUNTY TOTAL							

* Attach subcontractor(s) report(s)

** Must balance with Detail Sheet(s)

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

Sworn to and subscribed before me,

This the _____ day of _____, 20____

Signed

Notary Public

My Commission Expires: _____

Print or Type Name of Above

Seal

NOTE:

This certified statement may be subject to audit.

STATE OF NORTH CAROLINA SALES AND USE TAX REPORT DETAIL

CONTRACTOR: _____

Page 2 of

SUBCONTRACTOR _____

FOR PERIOD: _____

PROJECT: _____

PURCHASE DATE	VENDOR NAME	INVOICE NUMBER	TYPE OF PROPERTY	INVOICE TOTAL	COUNTY TAX PAID	COUNTY OF SALE *
				\$	\$	
				TOTAL:	\$	

* If this is an out-of-state vendor, the County of Sale should be the county to which the merchandise was shipped.

UNCW FACILITIES DIG AND EXCAVATING PERMIT REQUEST

ANY PENETRATIONS INTO THE GROUND ON UNCW PROPERTY REQUIRE A DIG PERMIT

When locating of underground utilities is complete an approved copy of this form will be emailed to the UNCW contact person or Project Manager.

A DETAILED DRAWING OR SKETCH OF THE DIG LOCATION MUST BE ATTACHED TO THIS REQUEST.
(Maps are available from Physical Plant or the Project Manager)

Please submit request **14 BUSINESS DAYS before** the planned dig start date to the Work Control Desk or email to Ellen Boyd and Serinda Moulton (moultons@uncw.edu; boyde@uncw.edu). Permits are only good for **10 business days** from the approval date. **DO NOT START** unless you have received an approved email copy of this request as well as a "no conflict" or "marked" Positive Response from North Carolina One-Call, Inc.

UNCW Contact or Project manager: _____ Today's Date: _____
Email Address: _____ Dig Start Date: _____
Office Phone #: _____ Cell Phone #: _____

☐ Please Check the box if you would like to be present during the Locate.

☐ Check here for flags only Departmental Fund #: _____

Dig Location: _____

Purpose of digging: _____

Company doing the digging: _____ Phone #: _____

Certified Equipment operator: _____

Responsible Supervisor: _____ 811 Ticket #: _____

All soil on UNCW's main campus is defined as Type C. The slope will be consistent with the NC OSHA standards, section 652 (b.1), which states: excavations shall be sloped at an angle no steeper than one and one-half (1 ½') horizontal to every one foot (1') vertical. (34 degrees measured from the horizontal.)

There are also electrical, fiber optic and cable tv conductors owned by private companies on campus.
It is the responsibility of the person requesting the dig permit to contact North Carolina One-Call Center, Inc.
(Dial 811 if in state or 1-800-632-4949) to have them located.

FOR PHYSICAL PLANT USE ONLY

WORK ORDER NO.: _____

Area utilities located and identified by: _____ Date: _____
Complete and approved for payment: _____ Date: _____
Comments: _____

FOR PROJECT MANAGER USE ONLY

Project Number: _____
Fund #: _____
Title: _____

GUIDELINES FOR RECRUITMENT AND SELECTION OF MINORITY BUSINESSES FOR PARTICIPATION IN UNIVERSITY OF NORTH CAROLINA 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 University of North Carolina construction projects in the amount of \$300,000 to \$2,000,000. The legislation provides that the State (University of North Carolina) 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 through The University 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 constituent 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 University of North Carolina 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. The University of North Carolina

The University of North Carolina will be responsible for the following:

- a. Reviewing the apparent low bidders' statutory compliance with the requirements listed in the proposal prior to award of contracts. The State (University of North Carolina) reserves the right to reject any or all bids and to waive informalities.
- b. Monitoring of contractors' compliance with minority business requirements in the contract documents during construction.
- c. Providing statistical data and required reports to the HUB Office.

d. Resolving any protest and disputes arising after implementation of the plan.

3. Constituent Institutions of The University of North Carolina

Before awarding a contract, constituent institution shall do the following:

- a. Implement the University of North Carolina HUB plan.
- 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 University of North Carolina.
- g. Evaluate documentation to determine good faith effort has been achieved for minority business utilization prior to recommendation of award to University of North Carolina.
- h. Review prime contractors' pay applications for compliance with minority business utilization commitments prior to payment.
- i. Document evidence of implementation of Owner's responsibilities.

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 University of North Carolina.
- f. Make documentation showing evidence of implementation of Designer's responsibilities available for review by University of North Carolina 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 University of North Carolina 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, University of North Carolina, 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 D: 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 E: These guidelines shall apply upon promulgation on University construction projects. Copies of these guidelines may be obtained from The University of North Carolina, (physical address) 910 Raleigh Road, Chapel Hill North Carolina, 27515, (mail address) PO Box 2688, Chapel Hill, North Carolina, 27515-2688, phone (919) 962-1000, Website:

http://www.northcarolina.edu/info/vendors/UNC_HUB_Guidelines2002_Rev 7-10

SECTION F: In addition to these guidelines, there will be issued with each construction bid package provisions for contractual compliance providing MBE participation in State building projects. An explanation of the process follows, titled “MINORITY BUSINESS CONTRACT PROVISIONS (CONSTRUCTION)” along with relevant forms for its implementation (“Identification of Minority Business Participation” form, Affidavits A, B, C, D and Appendix E).

MINORITY BUSINESS CONTRACT PROVISIONS (CONSTRUCTION)

APPLICATION:

The **Guidelines for Recruitment and Selection of Minority Businesses for Participation in University of North Carolina 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 University of North Carolina, (physical address) 910 Raleigh Road, Chapel Hill North Carolina, 27515, (mail address) PO Box 2688, Chapel Hill, North Carolina, 27515-2688, phone (919) 962-1000, Website:
http://www.northcarolina.edu/info/vendors/UNC_HUB_Guidelines2002_Rev_7-10

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 (by using the “Identification of Minority Business Participation” form provided in the bid document), the minority businesses that will be utilized on the project with corresponding total dollar value of the bid. In addition, the bidder must submit with his/her bid an 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, if the portion of work to be performed by minority firms is equal to or greater than 10% of the bidder’s total contract price. Affidavit C includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, and lists the participating minority firms with the dollar value of their contracts.

OR

Provide Affidavit D, if the portion of work to be performed by minority firms is less than 10% of the bidder’s total contract price. Affidavit D includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, lists the participating minority firms with the dollar value of their contracts and includes **documentation of Good Faith Effort**.

OR

Have provided Affidavit B with his/her bid as noted above, 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.

Summary of required submissions:

(use check boxes to assist in ensuring that all appropriate forms are submitted)

**ALL BIDDERS SUBMIT
WITH THEIR BID:**

- ☐ “Identification of Minority Business Participation” form

AND EITHER

- ☐ Affidavit A – “Listing of Good Faith Efforts”

OR

- ☐ Affidavit B – “Intent to Perform Contract with Own Workforce”

=====

**IN ADDITION, THE
APPARENT LOWEST
RESPONSIVE,
RESPONSIBLE BIDDER
SUBMITS (IF HE HAS
NOT SUBMITTED
AFFIDAVIT B):**

- ☐ Affidavit C – “Portion of the Work to be Performed by Minority Firms” if the percentage of work to be performed by minority firms is 10% or more. This form is to be submitted within 72 hours of notification of being low bidder.

OR

- ☐ Affidavit D “Good Faith Efforts” if the percentage of work to be performed by minority firms is less than 10%.

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 (University of North Carolina) 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 (The University of North Carolina) 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 (The University of North Carolina) whether to terminate the contract for breach.

In determining whether a contractor has made Good Faith Efforts, the University of North Carolina 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.

The University of North Carolina - **AFFIDAVIT A – Listing of Good Faith Efforts**

County of _____

Affidavit of _____

(Name of Bidder)

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.

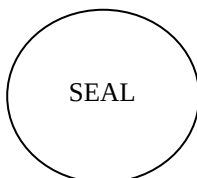
The undersigned, if apparent low bidder, will enter into a formal agreement with the firms listed in the Identification of Minority Business Participation schedule conditional upon scope of contract to be executed with the Owner. Substitution of contractors must be in accordance with GS143-128.2(d) Failure 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 _____

**The University 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

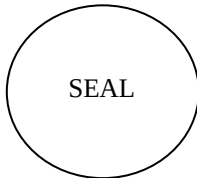
The Bidder agrees to provide any additional information or documentation requested by the owner in support of the above statement. The Bidder agrees to make a Good Faith Effort to utilize minority suppliers where possible.

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 _____

The University 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

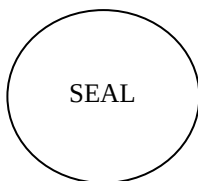
*Minority categories: Black, African American (**B**), Hispanic (**H**), Asian American (**A**) American Indian (**I**), Female (**F**) Socially and Economically Disadvantaged (**D**)

**** 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 _____

Do not submit with bid Do not submit with bid Do not submit with bid Do not submit with bid

University of North Carolina AFFIDAVIT D – Good Faith Efforts

County of _____

(Note this form is to be submitted only by the apparent lowest responsible, responsive bidder.)

If the goal of 10% participation by HUB Certified/ minority business **is not** achieved, the Bidder shall provide the following documentation to the Owner of his good faith efforts:

Affidavit of _____ I do hereby certify that on the
(Name of Bidder)

(Project Name)

Project ID# _____ Amount of Bid \$ _____

I will expend a minimum of _____% of the total dollar amount of the contract with HUB certified/ minority business enterprises. Minority businesses will be employed as construction subcontractors, vendors, suppliers or providers of professional services. Such work will be subcontracted to the following firms listed below.

(Attach additional sheets if required)

Name and Phone Number	*Minority Category	**HUB Certified Y/N	Work Description	Dollar Value

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

**** HUB Certification with the state HUB Office required to be counted toward state participation goals.**

Examples of documentation that may be required to demonstrate the Bidder's good faith efforts to meet the goals set forth in these provisions include, but are not necessarily limited to, the following:

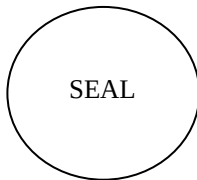
- A. Copies of solicitations for quotes to at least three (3) minority business firms from the source list provided by the State for each subcontract to be let under this contract (if 3 or more firms are shown on the source list). Each solicitation shall contain a specific description of the work to be subcontracted, location where bid documents can be reviewed, representative of the Prime Bidder to contact, and location, date and time when quotes must be received.
- B. Copies of quotes or responses received from each firm responding to the solicitation.
- C. A telephone log of follow-up calls to each firm sent a solicitation.
- D. For subcontracts where a minority business firm is not considered the lowest responsible sub-bidder, copies of quotes received from all firms submitting quotes for that particular subcontract.
- E. Documentation of any contacts or correspondence to minority business, community, or contractor organizations in an attempt to meet the goal.
- F. Copy of pre-bid roster
- G. Letter documenting efforts to provide assistance in obtaining required bonding or insurance for minority business.
- H. Letter detailing reasons for rejection of minority business due to lack of qualification.
- I. Letter documenting proposed assistance offered to minority business in need of equipment, loan capital, lines of credit, or joint pay agreements to secure loans, supplies, or letter of credit, including waiving credit that is ordinarily required.

Failure to provide the documentation as listed in these provisions may result in rejection of the bid and award to the next lowest responsible and responsive bidder.

Pursuant to GS143-128.2(d), the undersigned will enter into a formal agreement with Minority Firms for work listed in this schedule conditional upon execution of a contract with the Owner. Failure to fulfill this commitment may constitute a breach of the contract.

Do not submit with bid Do not submit with bid Do not submit with bid Do not submit with bid
The undersigned hereby certifies that he or she has read the terms of
this commitment and is authorized to bind the bidder to the
commitment herein set forth.

Date: _____ Name of Authorized Officer: _____
Signature: _____
Title: _____



State of _____, County of _____
Subscribed and sworn to before me this _____ day of _____ 20____
Notary Public _____
My commission expires _____

APPENDIX E

MBE DOCUMENTATION FOR CONTRACT PAYMENTS

Prime Contractor/Architect: _____

Address & Phone: _____

Project Name: _____

Pay Application #: _____ Period: _____

The following is a list of payments to be made to minority business contractors 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**) Socially and Economically Disadvantaged (**D**)

Date: _____

Approved/Certified By: _____

Name

Title

Signature

Signature certifies that any minority firms not previously verified in the bid/award process have been appropriately verified, services have been rendered, and payment is due as processed.

****THIS DOCUMENT MUST BE SUBMITTED WITH EACH PAY REQUEST & FINAL PAYMENT****

FORM OF PROPOSAL

Film Studies Building

University of North Carolina Wilmington

SCO #19-20473-01A

Contract: _____

Bidder: _____

Date: _____

The undersigned, as bidder, hereby declares that the only person or persons interested in this proposal as principal or principals is or are named herein and that no other person than herein mentioned has any interest in this proposal or in the contract to be entered into; that this proposal is made without connection with any other person, company or parties making a bid or proposal; and that it is in all respects fair and in good faith without collusion or fraud. The bidder further declares that he has examined the site of the work and the contract documents relative thereto, and has read all special provisions furnished prior to the opening of bids; that he has satisfied himself relative to the work to be performed. The bidder further declares that he and his subcontractors have fully complied with NCGS 64, Article 2 in regard to E-Verification as required by Section 2 (c) of Session Law 2013-418, codified as N.C. Gen. Stat. § 143-129(j).

The Bidder proposes and agrees if this proposal is accepted to contract with the

State of North Carolina acting through the
Board of Trustees of the Endowment Fund of the University of North Carolina at Wilmington

in the form of contract specified below, to furnish all necessary materials, equipment, machinery, tools, apparatus, means of transportation and labor necessary to complete the construction of:

Film Studies 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, and the University of North Carolina Wilmington and Becker Morgan Group, Inc. with a definite understanding that no money will be allowed for extra work except as set forth in the General Conditions and the contract documents, for the sum of:

SINGLE PRIME CONTRACT:

Base Bid:

_____ Dollars (\$)_____

General Subcontractor:

_____ Lic _____

Plumbing Subcontractor:

_____ Lic _____

Mechanical Subcontractor:

_____ Lic _____

Electrical Subcontractor:

_____ Lic _____

GS143-128(d) requires all single prime bidders to identify their subcontractors for the above subdivisions of work. A contractor whose bid is accepted shall not substitute any person as subcontractor in the place of the subcontractor listed in the original bid, except (i) if the listed subcontractor's bid is later determined by the contractor to be non-responsible or non-responsive or the listed subcontractor refuses to enter into a contract for the complete performance of the bid work, or (ii) with the approval of the awarding authority for good cause shown by the contractor.

ALTERNATES:

Should any of the alternates as described in the contract documents be accepted, the amount written below shall be the amount to be "added to" the base bid.

GENERAL CONTRACT:

Alternate No. 1: Interior Fit-out of Cinema Room 1106

(Add) _____ Dollars (\$) _____

Alternate No. 2: Install Enhanced Landscaping per Sheet L-501

(Deduct) _____ Dollars (\$) _____

Alternate No. 3: Install acoustic isolation brackets in exteriors walls of sound stage. See section 092216 Non-Structural Metal Framing.

(Add) _____ Dollars (\$) _____

Alternate No. 4: Owner Preferred Brands, Door Hardware – Section 087100
Locksets, Latches, Door Closers, Operators, Magnetic Hold-Open Devices, and Hinges

(Add) (Deduct) _____ Dollars (\$) _____

Alternate No. 5: Owner Preferred Brands, Hollow Metal Doors and Frames – Section 081113

(Add) (Deduct) _____ Dollars (\$) _____

Alternate No. 6: Owner Preferred Brands, Flush Wood Doors – Section 081416

(Add) (Deduct) _____ Dollars (\$) _____

Alternate No. 7: Owner Preferred Brands, Plastic Toilet Compartments – Section 102113.19

(Add) (Deduct) _____ Dollars (\$) _____

The bidder further proposes and agrees hereby to commence work under this contract on a date to be specified in a written order of the designer and shall fully complete all work thereunder within the time specified in the Supplementary General Conditions Article 23. Applicable liquidated damages amount is also stated in the Supplementary General Conditions Article 23.

MINORITY BUSINESS PARTICIPATION REQUIREMENTS

Provide with the bid - Under GS 143-128.2(c) the undersigned bidder shall identify **on its bid** (Identification of Minority Business Participation Form) the minority businesses that it will use on the project with the total dollar value of the bids that will be performed by the minority businesses. **Also** list the good faith efforts (Affidavit **A**) made to solicit minority participation in the bid effort.

NOTE: A contractor that performs all of the work with its own workforce may submit an Affidavit (**B**) to that effect in lieu of Affidavit (**A**) required above. The MB Participation Form must still be submitted even if there is zero participation.

After the bid opening - The Owner will consider all bids and alternates and determine the lowest responsible, responsive bidder. Upon notification of being the apparent low bidder, the bidder shall then file within 72 hours of the notification of being the apparent lowest bidder, the following:

An Affidavit (**C**) that includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, which is equal to or more than the 10% goal established. This affidavit shall give rise to the presumption that the bidder has made the required good faith effort and Affidavit D is not necessary;

*** OR ***

If less than the 10% goal, Affidavit D of its good faith effort to meet the goal shall be provided. The document must include evidence of all good faith efforts that were implemented, including any advertisements, solicitations and other specific actions demonstrating recruitment and selection of minority businesses for participation in the contract.

Note: Bidders must always submit **with their bid** the Identification of Minority Business Participation Form listing all MB contractors, vendors and suppliers that will be used. If there is no MB participation, then enter none or zero on the form. Affidavit A or Affidavit B, as applicable, also must be submitted with the bid. Failure to file a required affidavit or documentation with the bid or after being notified apparent low bidder is grounds for rejection of the bid.

Proposal Signature Page

The undersigned further agrees that in the case of failure on his part to execute the said contract and the bonds within ten (10) consecutive calendar days after being given written notice of the award of contract, the certified check, cash or bid bond accompanying this bid shall be paid into the funds of the owner's account set aside for the project, as liquidated damages for such failure; otherwise the certified check, cash or bid bond accompanying this proposal shall be returned to the undersigned.

Respectfully submitted this day of _____

(Name of firm or corporation making bid)

WITNESS:

By: _____
Signature

(Proprietorship or Partnership)

Name: _____
Print or type

Title _____
(Owner/Partner/Pres./V.Pres)

Address _____

ATTEST:

By: _____

License No. _____

Title: _____
(Corp. Sec. or Asst. Sec. only)

Federal I.D. No. _____

Email Address: _____

(CORPORATE SEAL)

Addendum received and used in computing bid (please check):

Addendum No. 1 _____ Addendum No. 3 _____ Addendum No. 5 _____ Addendum No. 6 _____

Addendum No. 2 _____ Addendum No. 4 _____ Addendum No. 6 _____ Addendum No. 7 _____

FORM OF BID BOND

KNOW ALL MEN BY THESE PRESENTS THAT _____

_____ as
principal, and _____, as surety, who is
duly licensed to act as surety in North Carolina, are held and firmly bound unto the State of
North Carolina, acting through the Board of Trustees of the Endowment Fund of the
University of North Carolina at Wilmington as obligee, in the penal sum of
_____ DOLLARS, lawful money of the United States of America,
for the payment of which, well and truly to be made, we bind ourselves, our heirs, executors,
administrators, successors and assigns, jointly and severally, firmly by these presents.

Signed, sealed and dated this ____ day of ____ 20__

WHEREAS, the said principal is herewith submitting proposal for _____
and the principal desires to file this bid bond in lieu of making
the cash deposit as required by G.S. 143-129.

NOW, THEREFORE, THE CONDITION OF THE ABOVE OBLIGATION is such, that
if the principal shall be awarded the contract for which the bid is submitted and shall execute
the contract and give bond for the faithful performance thereof within ten days after the award
of same to the principal, then this obligation shall be null and void; but if the principal fails to
so execute such contract and give performance bond as required by G.S. 143-129, the surety
shall, upon demand, forthwith pay to the obligee the amount set forth in the first paragraph
hereof. Provided further, that the bid may be withdrawn as provided by G.S. 143-129.1

_____(SEAL)

_____(SEAL)

_____(SEAL)

_____(SEAL)

_____(SEAL)

FORM OF CONSTRUCTION CONTRACT

(ALL PRIME CONTRACTS)

THIS AGREEMENT, made the _____ day of _____ in the year of 20__ by and between _____

hereinafter called the Party of the First Part and the State of North Carolina, acting through the Board of Trustees of the Endowment Fund of the University of North Carolina at Wilmington hereinafter called the Party of the Second Part.

WITNESSETH:

That the Party of the First Part and the Party of the Second Part for the consideration herein named agree as follows:

1. Scope of Work: The Party of the First Part shall furnish and deliver all of the materials, and perform all of the work in the manner and form as provided by the following enumerated plans, specifications and documents, which are attached hereto and made a part thereof as if fully contained herein: advertisement; Instructions to Bidders; General Conditions; Supplementary General Conditions; specifications; accepted proposal; contract; performance bond; payment bond; power of attorney; workmen's compensation; public liability; property damage and builder's risk insurance certificates; approval of attorney general; and drawings, titled: CONSTRUCTION DOCUMENTS

Consisting of the following sheets:

SHEET No.	SHEET TITLE
GENERAL	
G001	COVER SHEET
G002	CODE SUMMARY
G003	LIFE SAFETY PLAN
CIVIL	
C1.01	EXISTING CONDITIONS SURVEY
C1.02	EXISTING CONDITIONS SURVEY
C2.01	SITE PLAN
C3.01	GRADING PLAN
C4.01	UTILITY PLAN
C5.01	PLAN AND PROFILE - SS O/F
C5.02	PLAN AND PROFILE - WATERLINE "A"
C6.01	EROSION CONTROL PLAN
C6.02	EROSION CONTROL DETAILS
C6.03	EROSION CONTROL DETAILS
C8.00	SITE DETAILS
C8.01	STORM DRAINAGE DETAILS

SSD-1	CFPUA SANITARY SEWER DETAILS
SSD-2	CFPUA SANITARY SEWER DETAILS
WSD-1	CFPUA WATER DETAILS
WSD-2	CFPUA WATER DISTRIBUTION DETAILS
C9.01	STORMWATER CONTROL MEASURE PLAN VIEW
C9.02	STORMWATER CONTROL MEASURE DETAILS
C9.03	STORMWATER CONTROL MEASURE DETAILS
C9.04	STORMWATER CONTROL MEASURE DETAILS
C9.05	STORMWATER CONTROL MEASURE LANDSCAPE PLAN
L5.01	LANDSCAPE PLAN
STRUCTURAL	
S-101	GENERAL NOTES
S-102	GENERAL NOTES
S-103	TYPICAL DETAILS AND STRUCTURAL MATERIAL INSPECTIONS
S-201	FOUNDATION AND SLAB PLAN - ALTERNATE #1
S-202	FOUNDATION AND SLAB PLAN - ALTERNATE #1
S-301	FOUNDATION SECTIONS AND DETAILS
ARCHITECTURAL	
A101	FLOOR PLAN
A102	FIRST FLOOR REFLECTED CEILING PLAN
A103	ROOF PLAN
A201	EXTERIOR ELEVATIONS
A301	CINEMA SECTIONS AND DETAILS
A302	WALL SECTIONS
A303	WALL SECTIONS
A401	ENLARGED TOILET PLANS AND SECTIONS
A402	ENLARGED CINEMA AND SECTIONS
A403	COLUMN DETAILS
A404	COLUMN DETAILS
A501	WALL TYPES AND DETAILS
A502	ENLARGED DETAILS
A601	DOOR AND WINDOW TYPES AND SCHEDULE
A602	FINISH SCHEDULE AND LEGEND
A603	WINDOW ELEVATIONS AND DETAILS
A701	INTERIOR ELEVATIONS
A702	INTERIOR ELEVATIONS
PLUMBING	
P100	PLUMBING COVER
P101	PLUMBING FLOOR PLAN
P401	ENLARGED AND ELEVATION VIEWS
P402	ENLARGED TOILETS

P501	PLUMBING DETAILS
P601	ISOMETRIC OF DOMESTIC WATER
P602	ISOMETRIC OF WASTE AND VENT PIPES
P603	PLUMBING SCHEDULES
MECHANICAL	
M100	MECHANICAL COVER SHEET
M101	MECHANICAL FLOOR PLAN
M401	ENLARGED FLOOR PLANS
M402	ENLARGED FLOOR PLANS
M403	ELEVATION VIEWS
M404	ELEVATION VIEWS
M501	DUCT DETAILS
M502	DETAILS
M503	ROUND DUCT DETAILS
M504	UL DETAILS
M505	SAMPLE DUCT LAYOUT
M601	MECHANICAL SCHEDULES
M602	MECHANICAL SCHEDULES
M603	DDC CONTROLS, PACKAGED HEAT PUMP CONTROL (PHP1 & PHP2)
M604	PACKAGED HEAT PUMP SYSTEM CONTROL (PHP3)
M605	SPLIT HEAT PUMP SYSTEM CONTROL (AHU4/CU4) AND FIRE ALARM MONITORING
M606	DDC CONTROLS, SPLIT SYSTEM HEAT PUMP SYSTEMS, WATER METER, EXHAUST FANS
ELECTRICAL	
E-100	ELECTRICAL TITLESHEET
ES-101	ELECTRICAL SITE PLAN
E-101	ELECTRICAL POWER PLANS
E-102	ELECTRICAL LIGHTING PLANS
E-103	ELECTRICAL SYSTEMS PLANS
E-401	SECTIONS
E-500	ELECTRICAL DETAILS
E-501	ELECTRICAL DETAILS
E-502	SYSTEMS DETAILS
E-503	ELECTRICAL LIGHTING DETAILS
E-600	ELECTRICAL SCHEDULES
FA-101	FIRE ALARM PLANS
FA-500	FIRE ALARM DETAILS

Dated: September 23, 2019 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 245 consecutive calendar days from said date. For each day in excess thereof, liquidated damages shall be as stated in Supplementary General Conditions. The Party of the First Part, as one of the considerations for the awarding of this contract, shall furnish to the Party of the Second Part a construction schedule setting forth planned progress of the project broken down by the various divisions or part of the work and by calendar days as outlined in Article 14 of the General Conditions of the Contract.

3. The Party of the Second Part hereby agrees to pay to the Party of the First Part for the faithful performance of this agreement, subject to additions and deductions as provided in the specifications or proposal, in lawful money of the United States as follows:

 _____ (\$ _____).

Summary of Contract Award:

4. In accordance with Article 31 and Article 32 of the General Conditions of the Contract, the Party of the Second Part shall review, and if approved, process the Party of the First Party's pay request within 30 days upon receipt from the Designer. The Party of the Second Part, after reviewing and approving said pay request, shall make payments to the Party of the First Part on the basis of a duly certified and approved estimate of work performed during the preceding calendar month by the First Party, less five percent (5%) of the amount of such estimate which is to be retained by the Second Party until all work has been performed strictly in accordance with this agreement and until such work has been accepted by the Second Party. The Second Party may elect to waive retainage requirements after 50 percent of the work has been satisfactorily completed on schedule as referred to in Article 31 of the General Conditions.

5. Upon submission by the First Party of evidence satisfactory to the Second Party that all payrolls, material bills and other costs incurred by the First Party in connection with the construction of the work have been paid in full, final payment on account of this agreement shall be made within thirty (30) days after the completion by the First Party of all work covered by this agreement and the acceptance of such work by the Second Party.

6. It is further mutually agreed between the parties hereto that if at any time after the execution of this agreement and the surety bonds hereto attached for its faithful performance, the Second Party shall deem the surety or sureties upon such bonds to be unsatisfactory, or if, for any reason, such bonds cease to be adequate to cover the performance of the work, the First Party shall, at its expense, within five (5) days after the receipt of notice from the Second Party so to do, furnish an additional bond or bonds in such form and amount, and with such surety or sureties as shall be satisfactory to the Second Party. In such event no further payment to the First Party shall be deemed to be

due under this agreement until such new or additional security for the faithful performance of the work shall be furnished in manner and form satisfactory to the Second Party.

7. The Party of the First Part attest that it and all of its subcontractors have fully complied with all requirements of NCGS 64 Article 2 in regards to E-Verification as required by Section 2.(c) of Session Law 2013-418, codified as N.C. Gen. Stat. § 143-129(j).

IN WITNESS WHEREOF, the Parties hereto have executed this agreement on the day and date first above written in _____ counterparts, each of which shall without proof or accounting for other counterparts, be deemed an original contract.

Witness:

Contractor: (Trade or Corporate Name)

(Proprietorship or Partnership)

By: _____

Title: _____
(Owner, Partner, or Corp. Pres. or Vice Pres. only)

Attest: (Corporation)

By: _____

Title: _____
(Corp. Sec. or Asst. Sec. only)

The State of North Carolina acting through the
Board of Trustees of the Endowment Fund of the
University of North Carolina at Wilmington

(CORPORATE SEAL)

(Agency, Department or Institution)

Witness:

By: _____

Title: _____

FORM OF PERFORMANCE BOND

Date of Contract: _____

Date of Execution: _____
Name of Principal
(Contractor) _____

Name of Surety: _____

Name of Contracting
Body: _____

Amount of Bond: _____

Project Film Studies Building at the University of North Carolina Wilmington

KNOW ALL MEN BY THESE PRESENTS, that we, the principal and surety above named, are held and firmly bound unto the above named contracting body, hereinafter called the contracting body, in the penal sum of the amount stated above for the payment of which sum well and truly to be made, we bind, ourselves, our heirs, executors, administrators, and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the principal entered into a certain contract with the contracting body, identified as shown above and hereto attached:

NOW, THEREFORE, if the principal shall well and truly perform and fulfill all the undertakings, covenants, terms, conditions and agreements of said contract during the original term of said contract and any extensions thereof that may be granted by the contracting body, with or without notice to the surety, and during the life of any guaranty required under the contract, and shall also well and truly perform and fulfill all the undertakings, covenants, terms, conditions and agreements of any and all duly authorized modifications of said contract that may hereafter be made, notice of which modifications to the surety being hereby waived, then, this obligation to be void; otherwise to remain in full force and virtue.

IN WITNESS WHEREOF, the above-bounden parties have executed this instrument under their several seals on the date indicated above, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

Executed in _____ counterparts.

Witness: _____

(Proprietorship or Partnership)

Attest: (Corporation)

By: _____

Title: _____
(Corp. Sec. or Asst. Sec. only)

(Corporate Seal)

Witness:

Countersigned:

(N.C. Licensed Resident Agent)

Name and Address-Surety Agency

Surety Company Name and N.C.
Regional or Branch Office Address

Contractor: (Trade or Corporate Name)

By: _____

Title: _____
(Owner, Partner, or Corp. Pres. or Vice
Pres. only)

(Surety Company)

By: _____

Title: _____
(Attorney in Fact)

(Surety Corporate Seal)

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 Film Studies Building at the University of North Carolina Wilmington

KNOW ALL MEN BY THESE PRESENTS, that we, the principal and surety above named, are held and firmly bound unto the above named contracting body, hereinafter called the contracting body, in the penal sum of the amount stated above for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the principal entered into a certain contract with the contracting body identified as shown above and hereto attached:

NOW, THEREFORE, if the principal shall promptly make payment to all persons supplying labor/material in the prosecution of the work provided for in said contract, and any and all duly authorized modifications of said contract that may hereafter be made, notice of which modifications to the surety being hereby waived, then this obligation to be void; otherwise to remain in full force and virtue.

IN WITNESS WHEREOF, the above-bounden parties have executed this instrument under their several seals on the date indicated above, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

Executed in _____ counterparts.

Witness:

(Proprietorship or Partnership)

Attest: (Corporation)

By: _____

Title: _____
(Corp. Sec. or Asst. Sec.. only)

(Corporate Seal)

Witness:

Countersigned:

(N.C. Licensed Resident Agent)

Name and Address-Surety Agency

Surety Company Name and N.C.
Regional or Branch Office Address

Contractor: (Trade or Corporate Name)

By: _____

Title _____
(Owner, Partner, or Corp. Pres. or Vice
Pres. only)

(Surety Company)

By: _____

Title: _____
(Attorney in Fact)

(Surety Corporate Seal)

Sheet for Attaching Power of Attorney

Sheet for Attaching Insurance Certificates

APPROVAL OF THE ATTORNEY GENERAL

SECTION 010090 – SUPPLEMENTARY GENERAL CONDITIONS

RELATION TO STANDARD FORMS: The Supplementary General Conditions contain changes and additions to the “Instructions to Bidders and General Conditions of the Contract, Standard Form For Construction Projects, University of North Carolina General Administration, Fifth Edition – January 2015”. Where any portion of an Article in the aforementioned “Instructions to Bidders” and “General Conditions of the Contract” is modified or voided by the Supplementary General Conditions, the unaltered provisions shall remain in effect.

MODIFICATIONS TO STANDARD FORMS: Modify and supplement Instructions to Bidders and General Conditions of the Contract as follows:

GENERAL CONDITIONS OF THE CONTRACT

1. ARTICLE 1 – DEFINITIONS

- a. Delete paragraph b, and replace with the following:

“b. The ‘Owner’ is the State of North Carolina through the University of North Carolina Wilmington.”
- b. Paragraph c: Add “the Designer is Becker Morgan Group, Inc.”
- c. Paragraph h: Add “the project name is Randall Library Life Safety, ADA, and Restroom Improvements.”
- d. Add the following new paragraph:

“cc. Latest edition” shall mean the current printed version of the referenced document issued up to 30 calendar days prior to date of receipt of bids, unless specified otherwise.”
- e. Add the following new paragraph:

“dd. ‘Drawings’ or ‘plans’ shall mean the drawings enumerated in the contract documents, as well as all the information in the detail manual (when applicable), addenda, and designer-prepared field drawings and clarification drawings.”
- f. Add the following new paragraph:

“ee. ‘Specifications’ mean this project manual and addenda thereto.”
- g. Add the following new paragraph:

“ff. All correspondence, reports, schedules, applications for payment, fax items, etc. shall contain proper title of project, code, item and SCO ID numbers, typical.”

2. ARTICLE 2 – INTENT AND EXECUTION OF DOCUMENTS

- a. Paragraph a: Add the following new sub-paragraphs:

1. These drawings and specifications represent the general dimensional and aesthetic requirements for various "in place" materials required to produce renovations and improvements acceptable to the owner for his intended use
2. It is the intent of these drawings and specifications to provide renovations, improvements, and associated appurtenances that are structurally sound and conforming to at least the minimum requirements of the North Carolina State Building Code.
3. The Contractor shall make all reasonable efforts to achieve this intent. If any detail shown on these drawings appears inconsistent with this intent, in the opinion of the Contractor, he shall notify the Designer in writing of his opinion, and await instructions from the Designer before proceeding with the work.
4. Where more detailed information is needed, or when an interpretation of the contract documents is required, the Contractor shall refer the matter in writing to the Designer prior to proceeding with the work. The Designer shall furnish the Contractor an interpretation in writing.
5. If the Contractor discovers errors, inconsistencies, discrepancies or omissions in the contract documents, the Contractor shall inform the Designer of such condition prior to proceeding with the work.
6. If the Contractor discovers errors, inconsistencies, discrepancies or omissions in the contract documents prior to bid, the Contractor shall request clarifications from the Designer and shall include in the bid price all work required to deliver a fully operational and ready to use system.
7. If inconsistencies, discrepancies or contradictions in the Contract Documents are discovered after the bid, the Contractor shall be deemed by submittal of his bid, to have bid the most costly as to labor, materials, duration, sequence and method of construction to provide the work.

3. ARTICLE 3 – CLARIFICATION AND DETAIL DRAWINGS

- a. Paragraph a: Add the following to the end of the paragraph: "If errors, inconsistencies or discrepancies in the contract documents are discovered by the Contractor, the Contractor shall inform the designer of such condition prior to proceeding with the work. The designer shall furnish the Contractor written clarification in a reasonable time, so as not to impact the progress of the work."

4. ARTICLE 5 – SHOP DRAWINGS, SUBMITTALS, SAMPLES, DATA

- a. Add the following new paragraph:
 - "e. This schedule must account for any resubmittals required to obtain approval from the Project Designer and Owner."

- b. Add the following new paragraph:

“f. No time extension will be granted for delays caused due to failure of the Contractor to properly review shop drawings prior to submittal to the Project Designer. All shop drawings shall indicate how materials relate to conditions of the project. Standard manufacturer's drawings that do not show how and where material is to be used will not be reviewed by the Project Designer. Shop drawings shall not be reproductions of contract documents. Coordination drawings are required in accordance with Article 14.”

5. ARTICLE 8 – MATERIALS, EQUIPMENT, EMPLOYEES

- a. Delete paragraph e, and replace with the following:

“e. The designer is the judge of equivalency of materials, products, equipment, assemblies, or installation methods proposed by the Contractor as equivalent to those specified

1. Each contractor shall obtain written approval from the designer for use of products, materials, equipment and assemblies claimed as equal to those specified. Substitution requests will only be considered up to 10 days prior to the bid date unless the product is no longer manufactured, to comply with governing authorities or as directed by the owner. Reference 012500, Substitution Procedures, for additional substitution requirements.

2. The Contractor shall obtain written approval from the Project Designer for the use of products, materials, or equipment claimed as equal to those listed in the specifications. Such approvals shall be obtained prior to the opening of the bids. The Contractor shall submit within twenty (20) calendar days following award of contract a complete list of materials to be used for the project for review and approval by the Project Designer. The list shall consist of materials, products and equipment as listed in the specifications, equals, or approved equals. When this list is approved by the Project Designer, no substitution will be permitted except in unusual or extenuating circumstances. If no list is submitted, the Contractor shall supply only materials, products, or equipment required by the specifications.”

- b. Add the following new paragraph:

“g. All construction personnel shall be respectful to all University of North Carolina Wilmington staff and students. Any disrespect, harassment, unwelcome comments or advances from any construction personnel toward any staff member or student shall constitute sufficient grounds for University of North Carolina Wilmington to request removal of any specific individuals from this project. Such action taken by the Owner shall not constitute grounds for a delay claim. The Owner will not be responsible for any delays caused to the project due to any individual being removed from the project. Project superintendents shall be held accountable for any incident of this nature.”

6. ARTICLE 10 – PERMITS, INSPECTIONS, FEES, REGULATIONS

- a. Add the following new paragraph:

“e. Notify UNCW EH&S a minimum of one day in advance prior to performing work requiring a Hot Work Permit.”

7. ARTICLE 11 – PROTECTION OF WORK, PROPERTY AND THE PUBLIC

- a. Add the following new paragraph:

“j. In case emergency contact is required, the Contractor shall furnish the Owner with names, pager numbers, and telephone numbers (day and night) of the project manager and superintendent. The numbers shall remain current for the duration of the project, and shall be updated as required.”

- b. Add the following new paragraph:

“k. The Owner will provide security as it deems prudent and necessary for its own protection. The Contractor shall be responsible for security and safety of the project within the project limits, including on-site materials. The Contractor and the Owner shall meet on a regular basis as required but not less than weekly to coordinate safety and security issues.”

- c. Add the following new paragraph:

“l. The Owner will conduct normal operations during the duration of the project. Unless otherwise stated, the campus buildings will be occupied and will operate on a normal schedule. This means that the Contractor will be required to schedule work around regular operations, special events, visitors and staff requirements. The Contractor shall coordinate with the Owner's representative to minimize any disruptions to the functions of the College.”

8. ARTICLE 12 – SEDIMENTATION POLLUTION CONTROL ACT OF 1973

- a. Add the following new paragraph:

“e. The Contractor shall comply with the following requirements: Equipment utilized during the construction activity on a site must be operated and maintained in a manner as to prevent the potential or actual pollution of the surface or ground waters. Fuels, lubricants, coolants, and hydraulic fluids, or any other petroleum products, shall not be discharged on the ground or into surface waters. Spent fluids shall be disposed of in a manner so as not to enter the waters, surface or ground, and in accordance with applicable state and federal disposal regulations. Any spilled fluids shall be cleaned up to the extent practicable and disposed of in a manner so as not to allow their entry into the waters, surface or ground, storm sewers, or drains on private or public property. Herbicide, pesticide, and fertilizer usage during the construction activity shall be restricted to those Materials approved by EPA and shall be used in accordance with label instructions. All wastes composed of construction materials shall be disposed of in

accordance with NC General Statutes, Chapter 130A, Article 9- Solid Waste Management, and rules governing the disposal of solid waste (NC Administrative Code Section 15A NCAC 13B).”

b. Add the following new paragraph:

“f. Minimum Monitoring and Reporting Requirements:

1. All sedimentation and erosion control of facilities shall be inspected by the Contractor at least once every seven calendar days and within 24 hours after any storm event of greater than 0.5 inches of rain per 24-hour period.
2. Storm water runoff discharges shall be inspected by visual observation for color, foam, outfall, staining, visible sheens, dry weather flows and muddy water (at the frequency described above) to evaluate the effectiveness of the pollution control facilities or practices. If any visible off-site sedimentation is leaving the site, corrective action shall be taken to reduce the discharge of sediments.
3. The Contractor shall submit to the Owner a written report of weekly inspections. Visible sedimentation found off the site shall be recorded with a brief explanation as to the measures taken to prevent future releases as well as any measures taken to clean up the sediment that has left the site. This record shall be made available to Department of Environmental Management or authorized agent upon request.”

c. Add the following new paragraph:

“g. Maintenance and Inspections:

1. The Contractor shall keep all erosion controls devices and materials in good repair. The Owner reserves the right, within 24 hours prior notice to the Contractor to repair any erosion control measures or materials as required, and deduct the cost of those repairs from the Contractor’s application for payment.
2. The owner’s representative may periodically evaluate the project for compliance with these requirements.”

9. ARTICLE 14 – CONSTRUCTION SUPERVISION AND SCHEDULE

a. Delete paragraph e, and replace with the following:

“e. The contractor shall employ an engineer, or a land surveyor licensed in the State of North Carolina to lay out the work. The engineer or land surveyor shall establish a benchmark nearby in a location where same will not be disturbed and where direct instrument sights may be taken. In such case, the engineer or land surveyor shall coordinate the project benchmark with known campus benchmarks.”

10. ARTICLE 15 – SEPARATE CONTRACTS AND CONTRACTOR RELATIONSHIPS

- a. Add the following new paragraph:

“g. E-Verify Compliance: Pursuant to Session Law 2013- 418, Contractor shall fully comply with the U.S. Department of Homeland Security employee legal status EVerify requirements for itself and all its subcontractors. Owner requires an affidavit attesting to Contractor’s compliance. Violation of the provision, unless timely cured, shall constitute a breach of contract.”

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

- a. Add the following new paragraph:

“h. Time:

1. The Contractor shall commence work to be performed under this agreement on a date to be specified in a written order form the designer and shall fully complete all work related to the installation of the new fire alarm by **June 29, 2018**; final completion of all work shall be completed by August 12, 2018. For each day in excess of the above stated dates, the Contractor shall pay to the Owner the sum of \$500.00 per day as liquidated damages reasonably estimated in advance to cover the losses to be incurred by the Owner by reason of failure of said Contractor to complete the work within the time specified, such time being in the essence of this contract and a material consideration thereof.”

12. ARTICLE 34 – MINIMUM INSURANCE REQUIREMENTS

- a. Paragraph b: Revise minimum limits and coverage as follows:

Bodily Injury	\$1,000,000 per occurrence
Property Damage	\$1,000,000 per occurrence/\$1,000,000 aggregate, and shall include explosion, utilities, and collapse (XUC) coverage. \$1,000,000 Combined Single Limit to satisfy both Bodily Injury and Property Damage.

- b. Delete paragraph c, and replace with the following:

“c. 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 subcontractors in the work and shall insure against the perils of fire, hurricane, 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. Property insurance specified in paragraph ‘c’ shall include the Owner, the Architect and his consultants, the Contractor and his subcontractors as additional insured parties in the policy.”

13. ARTICLE 38 – USE OF PREMISES

- a. Add the following new paragraph:

“e. Storage of construction materials shall be limited to the staging area, as defined in the contract documents.”

- b. Add the following new paragraph:

“f. Where equipment must cross walks, landscaping areas, or ramps, the Contractor shall provide ¾” plywood sheets for protection of these areas. Cross walks, landscaping areas, or ramps damaged by construction activity shall be repaired or replaced.”

- c. Add the following new paragraph:

“g. The construction site and staging areas as well as Owner’s adjacent campus areas shall be kept free of trash, litter, and debris at all times.”

- d. Add the following new paragraph:

“h. Add the following new paragraph: “Grass in the construction site shall be mowed as often as required to maintain a neat appearance. Tree protection shall extend at least to the drip line of the trees to be protected. Unless otherwise shown on the drawings, minimum tree protection shall include four-foot landscaping fencing supported with steel stakes four foot on center. All areas under the drip line of trees are off limits to vehicular traffic unless protected by plywood.”

- e. Add the following new paragraph:

“i. Landscape protection when required, shall be installed prior to the initial grading stage. No storage of any kind, access, or activity of any kind will be permitted inside the landscaping protection areas.”

- f. Add the following new paragraph:

“j. When required by the drawings, a construction fence shall be installed. The fence shall be construction of heavy-duty chain link material, have a minimum height of six feet and it shall have a continuous top tubular rail. Swing gates shall be included at all and every access to the enclosed area.”

14. ARTICLE 39 – CUTTING, PATCHING AND DIGGING

- a. Paragraph a: Add “The Contractor shall be responsible for locating underground utilities prior to excavation. The construction manager may obtain the services of a commercial utilities locator and/or various utility companies who may have lines inside the area. In addition, Contractors shall contact the Owner's Representative at least five days prior to excavation. The Contractor will be responsible for utility interruptions caused by construction operations including excavations.”

- b. Add the following new paragraph:

“d. All cutting and patching required to perform the work, and to install the specified products under a particular contract shall be performed under that particular contract. All patching work shall be made by craftsmen skilled in the required work on who may already be engaged on the project. All painting within previously painted areas shall be painted by the contract which caused the need for this painting, unless new finishes have been scheduled. All painting shall be by skilled painters who may already be engaged on the project.”

15. ARTICLE 40 – UTILITIES, STRUCTURES, SIGNS

- a. Delete paragraph a, and replace with the following:

“a. The contractor shall provide necessary and adequate facilities for water, electricity, gas, oil sewer, and other utility services which may be necessary and required for completion of the project. The University owns the water, sewer, gas, telephone and electrical utilities on campus. The contractor shall arrange for and provide all appurtenances necessary for the provision of temporary services, including connections to existing utilities. Temporary telephone service shall be obtained and paid for by the contractor through the University's telecommunications department. Connections for all other utilities shall be performed under the supervision of Physical Plant personnel. In all cases, the contractor shall give a minimum of 72 hours notice for the connection of all utilities.

The Contractor shall provide temporary electric, gas and water meters on University-owned utility services to the building. The University will read the meters on a monthly basis, and will pay for the cost of consumption for these utilities. The University reserves the right to back charge the contractor if the University finds negligence in the use of utilities.

Charges for telephone and data utilities will be charged to the contractor directly by UNCW Telecommunications Department on a monthly basis. Contractor is advised to confirm current telephone and data rates with UNCW Telecommunications Department (910) 962-4019.”

- b. Delete paragraph j, and replace with the following:

“j. General Contractor shall provide his own office facility including telephone and facsimile machines required at location on site approved by the Architect and Owner. The Office shall be weather-tight with lighting, electrical outlets, heating, cooling equipment and equipped with sturdy furniture, drawing rack and drawing display table. The office shall also include a desk and telephone/data outlet. General Contractor's office shall be large enough for his own use and for use as a coordination office to include meeting space with table and chairs for 16 people. Portable toilets must be provided on site. The Owner's toilet facilities shall not be used at any time during the project.

- c. Add the following new paragraph:

“m. It is imperative that Owner's utilities and other services be maintained at all times

except for scheduled interruptions. Any necessary utility interruptions shall be approved by the Owner's Representative at least three weeks in advance. If necessary, work shall be performed at night, over the weekend, or during holidays. No extra payment will be made for such work. When utility services cannot be interrupted for the length of time required, the Contractor shall make provisions for temporary services. Pedestrian traffic around the construction limits must be maintained in a clean and safe condition at all times.

16. ARTICLE 42 – GUARANTEE

- a. Add the following new paragraph:

“e. All warranty periods to be begin at ‘Final Acceptance’ date rather than at the ‘Substantial Completion’ date.”

17. ARTICLE 45 – TAXES

- a. Add the following new paragraph:

“f. Contractors shall submit monthly with their request for payment, a signed statement containing the amount of sales and use tax paid by the Contractor for that particular billing period on the documents included in the project specifications.

18. ARTICLE 48 – ASBESTOS-CONTAINING MATERIALS (ACM)

- a. Add the following:

“No asbestos containing material may be used in this facility, including but not limited to, sprayed-on insulation, pipe insulation, floor tile, mastic adhesive, patch materials, wiring insulation, or acoustical treatment.”

END OF SECTION 010090

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. Phased construction.
4. Work by Owner.
5. Owner-furnished, Contractor-installed products
6. Owner-furnished products.
7. Access to site.
8. Work restrictions.
9. Specification and drawing conventions.

- B. Related Section:

1. Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.
2. Section "Construction Waste Management" for limitations and procedures governing removal of debris from Owner's facilities.

1.3 PROJECT INFORMATION

- A. Project Identification: UNCW Film Studies; SCO Project # 19-20473-01A; PM # 6034; BMG Project # 2018070.01.

1. Project Location: University of North Carolina Wilmington, Wilmington NC 28403

- B. Owner: University of North Carolina Wilmington

1. Owner's Representative: Lisa Seifert, seifertl@uncw.edu, (910) 962-7560.

- C. Architect: Becker Morgan Group, Inc.

1. Architect's Representative: Mark Loudermilk, mloudermilk@beckermorgan.com, (910) 341-7600.

- D. Architect's Consultants: The Architect has retained the following design professionals who have prepared designated portions of the Contract Documents:

1. Civil Engineer: John R. McAdams Company, Inc. Durham, NC (919) 316-5000

2. Structural Engineer: Woods Engineering, Wilmington, NC (910) 343-8007
3. Mechanical, Electrical, Plumbing Engineer: Sud Associates, PA Durham, NC (919) 493-5277

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of the Project is defined by the Contract Documents and consists of the following:
 1. New Film Studies Building: Site improvements and building construction of a 12,871 square foot facility. Construction includes concrete footings, concrete slab on grade, pre-engineered metal building frame, exterior metal siding and standing seam roofing, aluminum storefronts, hollow metal windows, wood and metal doors, sectional overhead door, interior metal stud partitions, interior finishes, plumbing, lighting, electrical and mechanical components. Special features include sound rated partitions and door assemblies, fire rated partitions, ADA lift and sloped interior floor. Site work includes excavation, extension and installation of utilities, earthwork, vehicular and pedestrian pavements, drainage, grading, storm water control, irrigation and landscaping.
- 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 WORK BY OWNER

- A. General: Cooperate fully with Owner so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.

1.7 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. Carpet Tile
2. Rubber Wall Base
3. VCT Flooring

1.8 OWNER-FURNISHED/OWNER-INSTALLED (OFOI) PRODUCTS

A. The Owner will furnish and install products indicated.

B. Owner-Furnished/Owner-Installed (OFOI) Products:

1. Acquisition and installation of information technology (IT) items including cabling, terminations, access points, physical equipment and other devices.
2. Acquisition and installation of academic program equipment, special technology items and other devices.

1.9 ACCESS TO SITE

A. 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.

B. Driveways, Walkways and Entrances:

1. Keep driveways, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
 - a. Access for Deliveries: Schedule deliveries to minimize use of driveways and entrances. Road and sidewalk blockages shall be scheduled fourteen (14) days in advance and may occur only after the University's approval. Warning signs, barricades, and detour information shall be placed as needed to accommodate, adequately warn, and protect campus pedestrians, including the handicapped. If required, flagmen shall direct traffic around the construction or detour area. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
 - b. Contractor may use a portion of the site (Project Staging Area) near the present loading dock for material storage provided all materials are within locked containers. Contractor shall coordinate with University for exact location and access.
 - c. Road, Driveway, Entrance, and Sidewalk Closings: The contractor shall make requests for approval for any street, alley, entrance, driveway, access way, or

sidewalk to be closed at least ten (10) work days prior to the date desired for closing. No such access will be closed without prior approval by the University. Pedestrian and vehicle traffic wayfinding around the construction limits must be maintained in a clean and safe condition at all times.

- d. **Street Maintenance:** Streets and adjacent property sites shall be kept free from run-off, litter and/or debris in any form from the project site and any that should appear shall be removed immediately. All mud collected on vehicle tires shall be removed before leaving the construction area. Adjacent roadways must be cleaned daily, if required, to prevent mud or dust from coating existing roadways. Contractors are prohibited from discharging any waste products from concrete trucks, concrete coring work, or any other unsuitable materials, fluids, or other products on the site, streets, or into the storm sewer system. Should the contractor fail to comply with these requirements, the University reserves the right, with twenty-four (24) hours' prior notice, to clean the offending area and deduct the cost from the Contractor's next application for payment.

2. **Parking:** Parking for personal vehicles on campus is not provided as parking is extremely limited. Contractors must limit parking of company vehicles and storage of materials as can be accommodated within the limits of the construction site and staging area. Contractors are subject to the University's parking regulations

1.10 WORK RESTRICTIONS

- A. **Work Restrictions, General:** Comply with restrictions on construction operations.
- B. **On-Site Work Hours:**
 1. Limit work to between 7:00am to 7:00 pm, Monday through Saturday, unless otherwise negotiated with Owner
 2. Hours for Utility Shutdowns: Coordinate with Owner.
- C. **Existing Utility Interruptions:** Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
 1. Notify Architect and Owner not less than 7 days in advance of proposed utility interruptions.
 2. Obtain Architect's and Owner's written permission before proceeding with utility interruptions.
- D. **Noise, Vibration, and Odors:** Coordinate operations that may result in noise and vibration, odors, or other disruption to Owner occupancy with Owner.
 1. Notify Architect and Owner not less than two days in advance of proposed disruptive operations.
 2. Obtain Architect's and Owner's written permission before proceeding with disruptive operations.
- E. **Nonsmoking Premises:** Smoking is not permitted.
- F. **Controlled Substances:** Use of controlled substances is not permitted.

- G. Employee Identification: Provide identification tags for Contractor personnel working on the Project site. Require personnel to utilize identification tags at all times.

1.11 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 the Drawings are described in detail in the Specifications. One or more of the following are used on the 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.

1.12 MISCELLANEOUS PROVISIONS

- A. Fire Arms: No fire arms, concealed or otherwise, are permitted on campus.
- B. Drug Free Workplace Requirement: The University is a drug-free work place. No drugs or alcohol are permitted on campus and employees on the work site under the influence of such substances shall be deemed sufficient cause for the University to permanently remove that individual from the project and University property. Such action shall not constitute grounds for a delay claim.
- C. Blasting: Blasting on University property is prohibited.
- D. Construction Site Fencing: Not Applicable
- E. Tree and Landscape Protection: All trees and landscaping shall be protected, and are off limits to vehicular traffic, material storage, soil stockpiles, pedestrian access, pathways, parking, etc. and shall be inviolate.
- F. Site Maintenance: Contractor is responsible for maintaining a clean, organized, safe job site, free of accumulated construction debris and trash. To that end, Contractor shall be responsible for cleaning their work areas weekly at a minimum and the proper disposal of construction debris and trash. Debris shall be secured in trucks so that material cannot fall or be blown from

trucks during transportation. Demolition debris is not to remain on the project site. Contractors or subcontractors must provide their own dumpsters and provide for periodic dumping for demolition debris.

- G. **Materials/Equipment Storage:** Storage of construction materials and equipment shall be limited to the Project Staging Area unless otherwise agreed to, in writing, in advance. Should the Contractor fail to remove any material or equipment stored outside the staging area within twenty-four (24) hours of notification from the University, the University shall have the right to remove and dispose of such materials from the campus and deduct the cost of such removal and disposition from the Contractor's next application for payment.
- H. **Security:** The University will only provide security it deems prudent and necessary for its own protection. The Contractor shall be responsible for the security and safety of the project within the project limits. The University must approve any security service instituted by the contractor.
- I. **Emergency Contacts:** The contractor shall furnish the University with names, telephone numbers (day and night), and pager numbers of the project manager and superintendent prior to beginning work and maintain current information for the project duration. In the event of an emergency identified by the Contractor, the designated University representative will be contacted.
- J. **Hot Work:** When the Contractor is performing work that produces heat, flame, or sparks on or in an existing building or other structure, the Contractor is required to obtain a "hot work" permit from the University.
- K. **Protection of the Work:** The Contractor shall protect all work in place. All materials, equipment, furnishings and finishes that are required to be new shall be in "new condition" at the time of final acceptance. Those that are deemed as not in "new condition" at the discretion of the Designer or Owner shall be removed and replaced at no additional cost to the Owner. In addition, where the project involves existing materials remaining in place, the Contractor must ensure these materials are adequately protected throughout the construction period. If damage occurs, Contractor shall repair damage to original condition to the Owner's satisfaction or replace damaged materials. Contractor shall not track dust or dirt into any occupied portions of buildings.
- L. **Contractor's Employees – Respectful Behavior:** All construction personnel shall be respectful of all members of the University community. Any incidents of disrespect, verbal abuse, threatening statements, unwelcome comments, unwelcome interaction or any form of harassment from any construction personnel toward any member of the University community is strictly prohibited. Any such act shall be deemed sufficient cause for the University to permanently remove any individual from the project and University property. Such action shall not constitute grounds for a delay claim.
- M. **Contractor's Employees – Responsive Behavior:** All construction personnel shall be responsive to requests to take action on any requirements of the contract documents and/or to correct any endangerment to the health and safety of the public. Any individual employee who ignores or refuses to take immediate action shall be identified as generating sufficient cause for the University to permanently remove them from the project and University property. Such action shall not constitute grounds for a delay claim.

N. Utilities:

1. Provisions for Utilities:

a. Utilities provided by Owner for Contractor's project use:

- 1) Electrical power service existing at project site
- 2) Water service existing at project site

2. Existing Utility Scheduled Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

- a. Notify Architect and Owner not less than two days in advance of proposed utility interruptions.
- b. Do not proceed with utility interruptions without Owner's written permission.

3. Utility Location/Interruptions: Each contractor doing excavation work is responsible for locating all existing underground utilities prior to commencing excavation. The Contractor shall be responsible for the associated cost of any utility interruption and repair due to his excavation if utility location was not requested, location procedures performed and followed prior to commencing excavation. The Contractor shall immediately notify the University and restore the service of any utility disrupted due to excavation or any contractor action whatever the circumstance. The University reserves the right to immediately restore the service of any utility disrupted due to actions of the contractor and deduct the cost of such restoration from the contractor's contract.

O. Signage: Job site trailer may display Contractor's logo sign. Contractor shall coordinate maximum signage dimensions, content, and placement details with Owner

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 01100

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: Modify 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 modifications 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 No. 1: Interior Fit-out of Cinema Room 1106
- B. Alternate No. 2: Install Enhanced Landscaping per Sheet L-501
- C. Alternate No. 3: Install acoustic isolation brackets in exterior walls of sound stage 1112. See section 092216 Non-Structural Metal Framing.

3.2 SCHEDULE OF OWNER PREFERRED ALTERNATES

- A. Alternate No. 4: Owner Preferred Brands, Door Hardware – Section 087100
 - 1. Locksets: Schlage
 - 2. Latches: Von Duprin
 - 3. Door Closers, Operators, and Magnetic Hold-Open Devices: LCN
 - 4. Hinges: Ives
- B. Alternate No. 5: Owner Preferred Brands, Hollow Metal Doors and Frames – Section 081113
 - 1. Steelcraft
- C. Alternate No. 6: Owner Preferred Brands, Flush Wood Doors – Section 081416
 - 1. Marshfield
- D. Alternate No. 7: Owner Preferred Brands, Plastic Toilet Compartments – Section 102113.19
 - 1. InPro Endurant

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.
- B. Related Sections:
 - 1. Division 01 Section "Alternates" for products selected under an alternate.
 - 2. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.
 - 3. Divisions 02 through 49 Sections for specific requirements and limitations 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.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
 - b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed 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.
 - 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.
2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

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

1.6 PROCEDURES

- A. Coordination: Modify 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 upon discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Substitution request is fully documented and properly submitted.
 - c. Requested substitution will not adversely affect Contractor's construction schedule.
 - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - e. Requested substitution is compatible with other portions of the Work.
 - f. Requested substitution has been coordinated with other portions of the Work.
 - g. Requested substitution provides specified warranty.
 - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.
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 offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 - b. Requested substitution does not require extensive revisions to the Contract Documents.
 - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - 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.
- k. May be rejected at Architects or Owners discretion.

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

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 01 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.
- B. Related Sections:
 - 1. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.
 - 2. Section 013300 "Submittal Procedures" for administrative requirements governing the preparation and submittal of the submittal schedule.

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. Submittal schedule.
 - c. Items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Architect at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use 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. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Architect.

- c. Architect's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
2. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the items, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
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 multiple line items for principal subcontract amounts in excess of five percent of Contract Sum.
 - a. Include separate line items under principal subcontracts for project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
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.
 - a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.
6. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
7. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
8. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.
9. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

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.
 - 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- 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. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 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 Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
 - 1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
 - 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 - 3. Provide summary documentation for stored materials indicating the following:
 - a. Materials previously stored and included in previous Applications for Payment.
 - b. Work completed for this Application utilizing previously stored materials.
 - c. Additional materials stored with this Application.
 - d. Total materials remaining stored, including materials with this Application.
- F. Transmittal: Submit five signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
 - 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from every entity lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of values.
 3. Contractor's construction schedule (preliminary if not final).
 4. Products list (preliminary if not final).
 5. Schedule of unit prices.
 6. Submittal schedule (preliminary if not final).
 7. List of Contractor's staff assignments.
 8. List of Contractor's principal consultants.
 9. Copies of building permits.
 10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 11. Initial progress report.
 12. Report of preconstruction conference.
 13. Certificates of insurance and insurance policies.
 14. Performance and payment bonds.
 15. Data needed to acquire Owner's insurance.
- I. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
- J. 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. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
 5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
 6. AIA Document G707, "Consent of Surety to Final Payment."
 7. Evidence that claims have been settled.
 8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.

9. Final liquidated damages settlement statement.
10. All requirements outlined in the General and Supplemental Conditions.

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 project coordination procedures.
 - 2. Administrative and supervisory personnel.
 - 3. Coordination drawings.
 - 4. Requests for Information (RFIs).
 - 5. Project Web site.
 - 6. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.
- C. Related Sections:
 - 1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
 - 2. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

- A. RFI: Request from Owner, Architect, or Contractor seeking information from each other during construction.

1.4 COORDINATION

- A. 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.

- B. 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.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors 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.
 - 9. Project closeout activities.
- D. Submission of Required Information
 - 1. Provide all required submissions in PDF form, unless specifically directed otherwise.
 - 2. Page and drawing sheet sizes are provided to allow printing of submissions when desired.

1.5 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings in accordance with requirements in individual Sections, 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. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are the Contractor's responsibility. If the Architect determines that the coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, the Architect will so inform the Contractor, who shall make changes as directed and resubmit.
- 2. Coordination Drawing Prints: Prepare coordination drawing prints in accordance with requirements of Division 01 Section "Submittal Procedures."
- 3. Sheet size: At least 8 1/2" x 11", but no larger than 30" x 42".
- 4. Refer to individual sections for coordination drawing requirements for work in those sections.

1.6 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 solution(s) 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. 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 RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for coordination information already indicated in the Contract Documents.
 - d. Requests for adjustments in the Contract Time or the Contract Sum.
 - e. Requests for interpretation of Architect's actions on submittals.
 - f. 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 Division 01 Section "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 five days of receipt of the RFI response.
 - D. 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 five days if Contractor disagrees with response.
 - E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Software log with not less than the following:
 - 1. Project name.
 - 2. Name and address of Contractor.
 - 3. Name and address of Architect.
 - 4. RFI number including RFIs that were dropped and not submitted.
 - 5. RFI description.
 - 6. Date the RFI was submitted.
 - 7. Date Architect's response was received.
 - 8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 - 9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.
- 1.7 PROJECT MEETINGS
- A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
- B. 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. Sustainable design requirements.
 - m. Preparation of record documents.
 - n. Use of the premises and existing building.
 - o. Work restrictions.
 - p. Working hours.
 - q. Owner's occupancy requirements.
 - r. Responsibility for temporary facilities and controls.
 - s. Procedures for moisture and mold control.
 - t. Procedures for disruptions and shutdowns.
 - u. Construction waste management and recycling.
 - v. Parking availability.
 - w. Office, work, and storage areas.
 - x. Equipment deliveries and priorities.
 - y. First aid.
 - z. Security.
 - aa. Progress cleaning.
 4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

- C. 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. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Review of mockups.
 - i. Possible conflicts.
 - j. Compatibility problems.
 - k. Time schedules.
 - l. Weather limitations.
 - m. Manufacturer's written recommendations.
 - n. Warranty requirements.
 - o. Compatibility of materials.
 - p. Acceptability of substrates.
 - q. Temporary facilities and controls.
 - r. Space and access limitations.
 - s. Regulations of authorities having jurisdiction.
 - t. Testing and inspecting requirements.
 - u. Installation procedures.
 - v. Coordination with other work.
 - w. Required performance results.
 - x. Protection of adjacent work.
 - y. Protection of construction and personnel.
 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Project Closeout Conference: Schedule and conduct a Project closeout conference, at a time convenient to Owner and Architect, but no later than 30 days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Project closeout.

2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Preparation of record documents.
 - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Submittal of written warranties.
 - d. Requirements for preparing sustainable design documentation.
 - e. Requirements for preparing operations and maintenance data.
 - f. Requirements for demonstration and training.
 - g. Preparation of Contractor's punch list.
 - h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - i. Submittal procedures.
 - j. Coordination of separate contracts.
 - k. Owner's partial occupancy requirements.
 - l. Installation of Owner's furniture, fixtures, and equipment.
 - m. Responsibility for removing temporary facilities and controls.
 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- E. Progress Meetings: Conduct progress meetings at biweekly and 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.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.

- 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site utilization.
 - 8) Temporary facilities and controls.
 - 9) Progress cleaning.
 - 10) Quality and work standards.
 - 11) Status of correction of deficient items.
 - 12) Field observations.
 - 13) Status of RFIs.
 - 14) Status of proposal requests.
 - 15) Pending changes.
 - 16) Status of Change Orders.
 - 17) Pending claims and disputes.
 - 18) Documentation of information for payment requests.
4. Minutes: Contractor 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.
- F. Coordination Meetings: Conduct Project coordination meetings at appropriate intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
1. 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 meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined 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.
 - b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - c. Review present and future needs of each contractor present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.

- 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site utilization.
 - 8) Temporary facilities and controls.
 - 9) Work hours.
 - 10) Hazards and risks.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Change Orders.
3. 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. Start-up construction schedule.
 - 2. Contractor's construction schedule.
 - 3. Daily construction reports.
 - 4. Material location reports.
 - 5. Field condition reports.
 - 6. Submittal Schedule.
 - 7. Special Reports.
- B. Related Sections:
 - 1. Section 013300 "Submittal Procedures" for submitting schedules and reports.
 - 2. Section 014000 "Quality Requirements" for submitting a schedule of tests and inspections.

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. Cost Loading: The allocation of the schedule of values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum, unless otherwise approved by Architect.
- C. 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 the Project.
- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

- E. Event: The starting or ending point of an activity.
- F. Float: The measure of leeway in starting and completing an activity.
 - 1. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
- G. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

1.4 SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. PDF electronic file.
 - 2. Three paper copies.
- B. Start-up construction schedule.
 - 1. Approval of cost-loaded start-up construction schedule will not constitute approval of schedule of values for cost-loaded activities.
- C. Start-up Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
 - 1. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.
- E. 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.
 - 2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
 - 3. Total Float Report: List of all activities sorted in ascending order of total float.
 - 4. Earnings Report: Compilation of Contractor's total earnings from the Notice to Proceed until most recent Application for Payment.
- F. Daily Construction Reports: Submit at monthly intervals.
- G. Material Location Reports: Submit at monthly intervals.
- H. Field Condition Reports: Submit at time of discovery of differing conditions.
- I. Special Reports: Submit at time of unusual event.

- J. Qualification Data: For scheduling consultant.
- K. Submittal Schedule: Submit three copies of schedule. Arrange the following information in a tabular format:
 - 1. Scheduled date for first submittal
 - 2. Specification Section number and title.
 - 3. Submittal Category (action or informational).
 - 4. Name of Subcontractor.
 - 5. Description of the Work covered.
 - 6. Scheduled date for Architect's final release or approval.

1.5 COORDINATION

- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.
- B. 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 final completion.
 - 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 principal 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 Division 01 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
 - 4. Startup and Testing Time: Include not less than 15 days for startup and testing.

5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial 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 by Owner: Include a separate activity for each portion of the Work performed by Owner.
 2. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Division 01 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 3. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use of premises restrictions.
 - f. Provisions for future construction.
 - g. Seasonal variations.
 - h. Environmental control.
 4. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Submittals.
 - b. Purchases.
 - c. Mockups.
 - d. Fabrication.
 - e. Sample testing.
 - f. Deliveries.
 - g. Installation.
 - h. Tests and inspections.
 - i. Adjusting.
 - j. Curing.
 - k. Startup and placement into final use and operation.
 5. 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.
- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.
- E. Cost Correlation: At the head of schedule, provide a cost correlation line, indicating planned and actual costs. On the line, show dollar volume of the Work performed as of dates used for preparation of payment requests.
1. Refer to Division 01 Section "Payment Procedures" for cost reporting and payment procedures.

- F. 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 RFIs.
 - 3. Rejected or unreturned submittals.
 - 4. Notations on returned submittals.
- G. Recovery Schedule: When periodic update indicates the Work is seven 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.
- H. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

2.2 START-UP CONSTRUCTION SCHEDULE

- A. Bar-Chart Schedule: Submit start-up horizontal bar-chart-type construction schedule within seven days of date established for the Notice of Award.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

- A. General: Prepare network diagrams using AON (activity-on-node) format.
- B. Start-up Network Diagram: Submit diagram within 14 days of date established for the Notice to Proceed. Outline significant construction activities for the first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
- C. CPM Schedule: Prepare Contractor's construction schedule using a cost- and resource-loaded, time-scaled CPM network analysis diagram for the Work.
 - 1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 30 days after date established for the Notice to Proceed.
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.
 - 2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
 - 3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.

4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule in order to correlate with Contract Time.
- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the start-up network diagram, prepare a skeleton network to identify probable critical paths.
1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Mobilization and demobilization.
 - c. Purchase of materials.
 - d. Delivery.
 - e. Fabrication.
 - f. Utility interruptions.
 - g. Installation.
 - h. Work by Owner that may affect or be affected by Contractor's activities.
 - i. Punch list and final completion.
 - j. Activities occurring following final completion.
 2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
 3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
 4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
 5. Cost- and Resource-Loading of CPM Schedule: Assign cost to construction activities on the CPM schedule. Do not assign costs to submittal activities. Obtain Architect's approval prior to assigning costs to fabrication and delivery activities. Assign costs under principal subcontracts for testing and commissioning activities, operation and maintenance manuals, punch list activities, Project record documents, and demonstration and training (if applicable), in the amount of 5 percent of the Contract Sum.
 - a. Each activity cost shall reflect an appropriate value subject to approval by Architect.
 - b. Total cost assigned to activities shall equal the total Contract Sum.
- E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall project schedule.
- F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:

1. Contractor or subcontractor and the Work or activity.
2. Description of activity.
3. Principal events of activity.
4. Immediate preceding and succeeding activities.
5. Early and late start dates.
6. Early and late finish dates.
7. Activity duration in workdays.
8. Total float or slack time.
9. Average size of workforce.
10. Dollar value of activity (coordinated with the schedule of values).

G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:

1. Identification of activities that have changed.
2. Changes in early and late start dates.
3. Changes in early and late finish dates.
4. Changes in activity durations in workdays.
5. Changes in the critical path.
6. Changes in total float or slack time.
7. Changes in the Contract Time.

H. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.

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

2.4 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. Approximate count of personnel at Project site.
3. Equipment at Project site.
4. Material deliveries.
5. High and low temperatures and general weather conditions, including presence of rain or snow.
6. Accidents.
7. Meetings and significant decisions.

8. Unusual events (refer to special reports).
9. Stoppages, delays, shortages, and losses.
10. Meter readings and similar recordings.
11. Emergency procedures.
12. Orders and requests of authorities having jurisdiction.
13. Change Orders received and implemented.
14. Change Directives received and implemented.
15. Services connected and disconnected.
16. Equipment or system tests and startups.
17. Partial completions and occupancies.
18. Substantial Completions authorized.

- B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site.
- C. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.5 SPECIAL REPORTS

- A. General: Submit special reports directly to Owner within one 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.

2.6 SUBMITTALS SCHEDULE

- A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.
1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.
 2. Initial Submittal: Submit concurrently with preliminary bar-chart schedule. Include submittals required during the first 60 days of construction. List those required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 - a. At Contractor's option, show submittals on the Preliminary Construction Schedule, instead of tabulating them separately.

3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's Construction Schedule.

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 one week before each regularly scheduled progress meeting.
 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 3. As the Work progresses, indicate final completion percentage for each activity.
- 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 013233 - PHOTOGRAPHIC 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 the following:
 - 1. Preconstruction photographs.
 - 2. Periodic construction photographs.
 - 3. Final Completion construction photographs.
 - 4. Preconstruction video recordings.
- B. Related Requirements:
 - 1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.

1.3 INFORMATIONAL SUBMITTALS

- A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph and video recording. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.
- B. Digital Photographs: Submit image files within three days of taking photographs.
 - 1. Submit photos on CD-ROM or thumb-drive. Include copy of key plan indicating each photograph's location and direction.
 - 2. Identification: Provide the following information with each image description:
 - a. Name of Project.
 - b. Name and contact information for photographer.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Date photograph was taken.
 - f. Description of location, vantage point, and direction.
 - g. Unique sequential identifier keyed to accompanying key plan.
- C. Video Recordings: Submit video recordings within seven days of recording.
 - 1. Submit video recordings on CD-ROM or thumb drive. Include copy of key plan indicating each video's location and direction.
 - 2. Identification: With each submittal, provide the following information:
 - a. Name of Project.

- b. Name and address of photographer.
- c. Name of Architect.
- d. Name of Contractor.
- e. Date video recording was recorded.
- f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.

1.4 FORMATS AND MEDIA

- A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels, and with vibration-reduction technology. Use flash in low light levels or backlit conditions.
- B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full high-definition mode with vibration-reduction technology. Provide supplemental lighting in low light levels or backlit conditions.
- C. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
- D. File Names: Name media files with sequential numbering suffix.

1.5 CONSTRUCTION PHOTOGRAPHS

- A. General: Take photographs with maximum depth of field and in focus.
 - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- B. Preconstruction Photographs: Before commencement of demolition, take photographs of Project site and surrounding area, including existing items to remain during construction, from different vantage points.
 - 1. Identify construction limits before taking construction photographs.
 - 2. Take 12 photographs of existing area to accurately record physical conditions at start of construction.
 - 3. Take additional photographs as required to record conditions of adjacent areas, and improvements.
- C. Periodic Construction Photographs: Take 12 photographs weekly coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.
- D. Final Completion Construction Photographs: Take 20 photographs after date of Substantial Completion for submission as Project Record Documents.
- E. Additional Photographs: Architect may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.

1. Three days' notice will be given, where feasible.
2. In emergency situations, take additional photographs within 24 hours of request.

1.6 CONSTRUCTION VIDEO RECORDINGS

- A. Narration: Describe scenes on video recording by audio narration while video recording is recorded. Include description of items being viewed, recent events, and planned activities. At each change in location, describe vantage point, location, direction (by compass point), and elevation or story of construction.
 1. Confirm date and time at beginning and end of recording.
 2. Begin each video recording with name of Project, Contractor's name, videographer's name, and Project location.
- B. Preconstruction Video Recording: Before starting demolition, record video recording of Project site and surrounding area from different vantage points.
 1. Identify construction limits before recording construction video recordings.
 2. Show existing area to accurately record physical conditions at start of demolition.
 3. Show protection efforts by Contractor.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013233

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:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

B. Related Sections:

1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
3. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
4. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

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."

1.4 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
 1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 2. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.

- a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.
3. 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 dates for purchasing.
 - h. Scheduled date of fabrication.
 - i. Scheduled dates for installation.
 - j. Activity or event number.

1.5 SUBMITTAL FORMATS

- A. Submittal Information: Include the following information in each submittal:
 1. Project name.
 2. Date.
 3. Name of Architect.
 4. Name of Contractor.
 5. Name of firm or entity that prepared submittal.
 6. Names of subcontractor, manufacturer, and supplier.
 7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
 8. Category and type of submittal.
 9. Submittal purpose and description.
 10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
 11. Drawing number and detail references, as appropriate.
 12. Indication of full or partial submittal.
 13. Location(s) where product is to be installed, as appropriate.
 14. Other necessary identification.
 15. Remarks.
 16. Signature of transmitter.
- B. Options: Identify options requiring selection by Architect.
- C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
- D. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

- E. Submittals Utilizing Web-Based Project Software: Prepare submittals as PDF files or other format indicated by Project management software.

1.6 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - 1. Email: Prepare submittals as PDF package and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.
 - a. Architect will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.
 - 2. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 - 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 - 4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, 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 15 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 15 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 21 days for initial review of each submittal.
- D. 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.
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

1.7 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams that show factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based on Architect's digital data drawing files is otherwise permitted.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.

- c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
- C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.
- 1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
 - 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
 - a. Project name and submittal number.
 - b. Generic description of Sample.
 - c. Product name and name of manufacturer.
 - d. Sample source.
 - e. Number and title of applicable Specification Section.
 - f. Specification paragraph number and generic name of each item.
 - 3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics and identification information for record.
 - 4. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
 - 5. 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.
 - 6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit three sets of Samples. Architect will retain one Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 2. Manufacturer and product name, and model number if applicable.
 3. Number and name of room or space.
 4. Location within room or space.
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- G. Certificates:
1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
 2. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
 3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
 4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
 5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
 6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.
- H. Test and Research Reports:
1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
 2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
 3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - a. Name of evaluation organization.
 - b. Date of evaluation.
 - c. Time period when report is in effect.
 - d. Product and manufacturers' names.
 - e. Description of product.
 - f. Test procedures and results.
 - g. Limitations of use.

1.8 DELEGATED-DESIGN SERVICES

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

1.9 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with indication in web-based Project management software. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.10 ARCHITECT'S REVIEW

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return.
 1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action.
 2. Submittals by Web-Based Project Management Software: Architect will indicate, on Project management software website, the appropriate action.
- 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. Architect will return without review submittals received from sources other than Contractor.
- F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

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.
- C. Related Sections:
 - 1. Retain first subparagraph below if Project requires schedule of tests and inspections.
 - 2. Section 013200 "Construction Progress Documentation" for developing a schedule of required tests and inspections.
 - 3. Divisions 02 through 49 Sections for specific test and inspection requirements.

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. Preconstruction Testing: Tests and inspections performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.

- D. 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.
- E. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.
- F. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- H. 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 or trades.
- I. 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 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.
- 1.6 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 to those indicated for this Project in material, design, and extent.
- 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, 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.

1.7 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. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
 - 3. 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 Division 01 Section "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 the 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. 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 modifications 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 Division 01 Section "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.
- B. Related Sections:
 - 1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

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, Architect, testing agencies, and authorities having jurisdiction.
- B. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- C. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.4 INFORMATIONAL SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.
- B. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage, including delivery, handling, and storage provisions for materials subject to water absorption or water damage, discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water damaged Work.
- 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. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.

- E. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.
 - 1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and requirements for replacing water-damaged Work.
 - 2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
 - 3. Indicate methods to be used to avoid trapping water in finished work.
- F. Dust-Control and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust-control 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. Locations of dust-control partitions at each phase of the work.
 - 2. Other dust-control measures.
 - 3. Waste management plan.

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 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. 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 rails.
- 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.
- D. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

2.2 TEMPORARY FACILITIES

- A. 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.
- B. Storage and Fabrication Sheds or Containers: Provide sheds or containers 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:
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Permanent HVAC System: 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.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

- A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
 - 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.

3.2 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
 - 1. Coordinate locations with Owner to limit interruptions to Owner's operations.

3.3 TEMPORARY UTILITY INSTALLATION

- A. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
- B. Sanitary Facilities:
 - 1. Toilets: 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.
- C. 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.
- D. 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.
- E. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.
- F. 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.
- G. Telephone Service:
 - 1. Provide a cellular telephone onsite during hours of work and for emergency use by construction crews.
 - 2. Post a list of important telephone numbers.
 - a. Police and fire departments.
 - b. Ambulance service.
 - c. Contractor's home office.
 - d. Architect's office.
 - e. Engineers' offices.
 - f. Owner's office.
 - g. Principal subcontractors' field and home offices.
- H. Electronic Communication Service: Provide secure WiFi wireless connection to internet with provisions for access by Architect and Owner.

3.4 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
 - 1. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion 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. Traffic Controls: Comply with requirements of authorities having jurisdiction.
 - 1. Protect existing site improvements to remain, including curbs, pavement, and utilities.
 - 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- D. Parking: Coordinate with Owner provisions for temporary offsite parking areas for construction personnel.
- E. Waste Disposal Facilities: Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."
- F. 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.
- G. Project Signs: Provide Project signs as indicated. 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.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. 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.
- B. 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 local regulation and permits.
- C. Security Enclosure and Lockup: Coordinate access to the building and security requirements with the Owner. Lock entrances at end of each work day.

- D. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- E. 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.

3.6 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. Controlled Construction Phase of Construction:
 - 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 daily readings over a forty-eight-hour period. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
 - c. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.7 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. 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 Substantial

Completion. 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.
2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

END OF SECTION 015000

SECTION 015639 – TEMPORARY TREE AND PLANT PROTECTION

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. This section covers work necessary for protection of existing trees during and after construction and land disturbance activities. The work shall include furnishing all labor, materials, tools, and equipment to perform all work and services necessary for, or incidental to, the furnishing and installation, complete, of all operations in connection with tree protection measures as shown on drawings and as specified, in accordance with provisions of the Contract Documents, and completely coordinated with work of all other trades. The Contractor shall insure that all tree protection measures are in place prior to construction as necessary. Contractor shall remove the measures once construction is complete with approval of the Designer, Owner, and/or controlling authorities.
- B. The areas requiring tree protection measures are indicated on the Drawings as all trees that are to remain after completion of the Work. The right is reserved to modify the use, location, and quantity of tree protection measures based on activities of the Contractor and as the Designer and Owner considers being the best interest of the Owner.
- C. Related Requirements:
 - 1. Division 01 Section "Temporary Facilities and Controls" for temporary site fencing.
 - 2. Division 31 Section "Site Clearing" for removing existing trees and shrubs.

1.3 DEFINITIONS

- A. Caliper: Diameter of a trunk measured by a diameter tape at 6 inches above the ground for trees up to, and including, 4-inch size; and 12 inches above the ground for trees larger than 4-inch size.
- B. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.
- C. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and indicated on Drawings.
- D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 SUBMITTALS

- A. Submittals shall be made in accordance with the Division 01 Section "Submittal Procedures".
- B. Product Data: For each type of product indicated.
- C. Tree Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.

1. Species and size of tree.
 2. Location on site plan.
 3. Include unique identifier for each.
 4. Reason for pruning.
 5. Description of pruning to be performed.
 6. Description of maintenance following pruning.
- D. Qualification Data: For qualified arborist and tree service firm.
- E. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.
- F. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.
- G. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.
1. Use sufficiently detailed photographs or videotape.
 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

1.5 QUALITY ASSURANCE

- A. Arborist Qualifications: Certified Arborist as certified by ISA and Licensed arborist in jurisdiction where Project is located.
- B. Pre-installation Conference: Conduct conference at Project site.
1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:
 - a. Construction schedule. Verify availability of materials, personnel, and equipment needed to make progress and avoid delays.
 - b. Enforcing requirements for protection zones.
 - c. Arborist's responsibilities.
 - d. Field quality control.

1.6 PROJECT CONDITIONS

- A. The following practices are prohibited within protection zones:
1. Storage of construction materials, debris, or excavated material
 2. Parking vehicles or equipment.
 3. Foot traffic.
 4. Erection of sheds or structures.
 5. Impoundment of water.
 6. Excavation or other digs unless otherwise indicated.
 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- B. Do not direct vehicle or equipment exhaust toward protection zones.

- C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Topsoil: Natural or cultivated top layer of the soil profile or manufactured topsoil; containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 1 inch in diameter; and free of weeds, roots, and toxic and other non-soil materials.
 - 1. Obtain topsoil only from well-drained sites where topsoil is 4 inches deep or more; do not obtain from bogs or marshes.
 - 2. Stockpiled topsoil from location shown on Drawings and Imported or manufactured topsoil complying with ASTM D 5268
- B. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following.
 - 1. Type: Double Shredded hardwood.
 - 2. Size Range: 3 inches maximum, 1/2 inch minimum.
 - 3. Color: Natural.
- C. Protection-Zone Fencing: Fencing fixed in position and meeting the requirements as shown on the Drawings.
- D. Protection-Zone Signage: Per the requirements and dimensions as shown on the Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- B. For the record, prepare written report, endorsed by arborist, listing conditions detrimental to tree and plant protection.

3.2 PREPARATION

- A. Locate and clearly identify trees, shrubs, and other vegetation to remain. Flag each tree trunk at 54 inches above the ground.
- B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.
- C. Tree-Protection Zones: Mulch areas inside tree-protection zones and other areas indicated.

1. Apply 4-inch average thickness of organic mulch. Do not place mulch within 6 inches of tree trunks.

3.3 TREE AND PLANT PROTECTION ZONES

- A. Protection Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people and animals from easily entering protected area. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.
- B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations per the approved Drawings.
- C. Maintain protection zones free of weeds and trash.
- D. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.
- E. Maintain protection-zone fencing and signage in good condition as acceptable to Designer and remove when construction operations are complete and equipment has been removed from the site.
 1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
 2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

3.4 EXCAVATION

- A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Division 31 Section "Earth Moving."
- B. Trenching near Trees: Where utility trenches are required within protection zones, hand excavate under or around tree roots or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning.
- C. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 3 inches back from new construction and as required for root pruning.
- D. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

3.5 ROOT PRUNING

- A. Prune roots that are affected by temporary and permanent construction. Prune roots as follows:

1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
 2. Cut Ends: Do not paint cut root ends.
 3. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil
 4. Cover exposed roots with burlap and water regularly.
 5. Backfill as soon as possible according to requirements in Division 31 Section "Earth Moving."
- B. Root Pruning at Edge of Protection Zone: Prune roots 12 inches outside of the protection zone, by cleanly cutting all roots to the depth of the required excavation.
- C. Root Pruning within Protection Zone: Clear and excavate by hand to the depth of the required excavation to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

3.6 CROWN PRUNING

- A. Prune branches that are affected by temporary and permanent construction. Prune branches as follows:
1. Prune trees to remain to compensate for root loss caused by damaging or cutting root system. Provide subsequent maintenance during Contract period as recommended by arborist.
 2. Pruning Standards: Prune trees according to ANSI A300 (Part 1) and the following.
 - a. Type of Pruning: Cleaning, Thinning, Raising and Reduction.
 - b. Specialty Pruning: Restoration and Vista.
 3. Cut branches with sharp pruning instruments; do not break or chop.
 4. Do not apply pruning paint to wounds.
- B. Chip removed branches and dispose of off-site.

3.7 RE-GRADING

- A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.
- B. Lowering Grade within Protection Zone: Where new finish grade is indicated below existing grade around trees, slope grade away from trees as recommended by arborist unless otherwise indicated.
1. Root Pruning: Prune tree roots exposed by lowering the grade. Do not cut main lateral roots or taproots; cut only smaller roots. Cut roots as required for root pruning.
- C. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.
- D. Minor Fill within Protection Zone: Where existing grade is 2 inches or less below elevation of finish grade, fill with topsoil. Place topsoil in a single un-compacted layer and hand grade to required finish elevations.

3.8 FIELD QUALITY CONTROL

- A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

3.9 REPAIR AND REPLACEMENT

- A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Owner and Designer.
 - 1. Submit details of proposed root cutting and tree and shrub repairs.
 - 2. Have arborist perform the root cutting, branch pruning, and damage repair of trees and shrubs.
 - 3. Treat damaged trunks, limbs, and roots according to arborist's written instructions.
 - 4. Perform repairs within 24 hours.
 - 5. Replace vegetation that cannot be repaired and restored to full-growth status, as determined by Owner and Designer.
- B. Trees: Remove and replace trees indicated to remain that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Owner and Designer determines are incapable of restoring to normal growth pattern.
 - 1. Provide new trees of same size and species as those being replaced for each tree that measures 4 inches or smaller in caliper size.
 - 2. Plant and maintain new trees as specified in Division 32 Section "Plants."
- C. Soil Aeration: Where directed by Architect, aerate surface soil compacted during construction. Aerate 10 feet beyond drip line and no closer than 36 inches to tree trunk. Drill 2-inch- diameter holes a minimum of 12 inches deep at 24 inches o.c. Backfill holes with an equal mix of augured soil and sand.

3.10 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove excess excavated material, displaced trees, trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 015639

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.
- B. Related Sections:
 - 1. Division 01 Section "Alternates" for products selected under an alternate.
 - 2. Section 012500 "Substitution Procedures" for requests for substitutions.
 - 3. Section 017700 "Closeout Procedures" for submitting warranties for contract closeout.
 - 4. Division 07 through 49 Sections for specific requirements for warranties on products and installations specified to be warranted.

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.
- C. Substitutions: Changes in products, materials, equipment and methods of construction from those required by the Contract Documents and proposed by the Contractor.

1.4 SUBMITTALS

- A. Comparable Product Requests: Submit three copies of each 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. Documentation: Show compliance with requirements for substitutions and the following, as applicable.
 - a. Statement indicating why specified material or product cannot be provided.
 - b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitution with the of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect and specific features and requirements indicated.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. List of similar installations for completed projects with project names and addresses and names and addresses of Architects and Owners.
 - g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
 - i. 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 a letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
 - j. Cost information, including a proposal of change, if any, in the Contract Sum.
 - k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
 - l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within 7 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 7 days of receipt of additional information or documentation, whichever is later.
 - a. Form of Acceptance: Indicated in Contract Documents, Pre-Bid Addendum, no substitutions will be considered after receipt of bids.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01 Section "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.

1.6 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. Store 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. Refer to Divisions 02 through 49. Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Division 01 Section "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.
 - 7. Where products are accompanied by the term "match sample", sample to be matched is Architects.
- 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: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements.
 - 4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements

5. Available Products: 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.
6. Available Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.
7. 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.
8. Product Options: Where Specifications indicate that the sizes, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide the specified product or system. Comply with provisions in Part 2 "Product Substitutions" Article for consideration of an unnamed product or system.

2.2 COMPARABLE PRODUCTS

- A. Timing: Architect will consider requests for substitution if received within 10 days prior to bid date and time. Requests received after that time may be considered or rejected at discretion of the Architect.
- B. 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. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 2. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 3. Substitution request is fully documented and properly submitted.
 4. Requested substitution will not adversely affect Contractor's Construction Schedule.
 5. Requested substitution has received necessary approvals of authorities having jurisdiction.
 6. Requested substitution is compatible with other portions of the Work.
 7. Requested substitution has been coordinated with other portions of the Work.
 8. Requested substitution provides specified warranty.

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.
 - 9. Correction of the Work.
- B. Related Sections:
 - 1. Section 013300 "Submittal Procedures" for submitting surveys.
 - 2. Section 017700 "Closeout Procedures" for final cleaning.

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 SUBMITTALS

- A. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:
 - 1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
 - 2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
 - 3. Products: List products to be used for patching and firms or entities that will perform patching work.
 - 4. Dates: Indicate when cutting and patching will be performed.

5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate how long services and systems will be disrupted.

1.5 PREINSTALLATION MEETINGS

- A. Layout Conference: Conduct conference at Project site.
 1. Prior to establishing layout of new perimeter and structural column grid(s), review building location requirements. Review benchmark, control point, and layout and dimension requirements. Inform Architect of scheduled meeting. Require representatives of each entity directly concerned with Project layout to attend, including the following:
 - a. Contractor's superintendent.
 - b. Professional surveyor responsible for performing Project surveying and layout.
 - c. Professional engineer responsible for performing site survey serving as basis for Project design.
 2. Review meanings and intent of dimensions, notes, terms, graphic symbols, and other layout information indicated on the Drawings.
 3. Review requirements for including layouts on Shop Drawings and other submittals.
 4. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For land surveyor.
- B. Certified Surveys: Submit two copies signed by land surveyor.
- C. Certificates: Submit certificate signed by land surveyor, certifying that location and elevation of improvements comply with requirements.
- D. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:
 1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
 2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
 3. Products: List products to be used for patching and firms or entities that will perform patching work.
 4. Dates: Indicate when cutting and patching will be performed.
- E. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.7 CLOSEOUT SUBMITTALS

- A. Final Property Survey: Submit two (2) copies showing the Work performed and record survey data.

1.8 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 - 1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
 - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety
 - 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
 - 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with requirements specified in other Sections.
- 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 the Architect for the visual and functional performance of in-place materials.

- 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.

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, 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 as needed.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of the Contractor, submit a request for information to Architect according to requirements in Division 01 Section "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 and existing conditions. If discrepancies are discovered, notify Architect promptly.
- B. Engage a land surveyor experienced in laying out the Work, using the following 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.
- D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- E. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
 1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.

3.5 INSTALLATION

- A. 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, unless otherwise indicated on Drawings.
- 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 satisfactory results as judged by Architect. 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 of type expected for Project.

- 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: Select tools or equipment that minimize production of excessive 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 portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
 - 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, as judged by Architect. Fit exposed connections together to form hairline joints.
- J. Repair or remove and replace damaged, defective, or nonconforming Work.
 - 1. Comply with Section 017700 "Closeout Procedures" for repairing or removing and replacing defective Work.

3.6 CUTTING AND PATCHING

- A. 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. Temporary Support: Provide temporary support of work to be cut.
- C. 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.
- D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

- E. 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 Division 31 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.
- F. 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.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.
- G. 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. Utilize containers intended for holding waste materials of type to be stored.
- 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.
- 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 Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- 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. Coordinate startup and adjusting of equipment and operating components with requirements in Division 01 Section "General Commissioning Requirements."
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Division 01 Section "Quality Requirements."

3.9 PROTECTION AND REPAIR OF INSTALLED CONSTRUCTION

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

END OF SECTION 017300

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

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 the following:
 - 1. Salvaging nonhazardous demolition and construction waste.
 - 2. Recycling nonhazardous demolition and construction waste.
 - 3. Disposing of nonhazardous demolition and construction waste.

1.3 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Achieve end-of-Project rates for salvage/recycling of 50 percent by weight of total non-hazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials.

1.5 ACTION SUBMITTALS

- A. Waste Management Plan: Submit plan within 7 days of date established for commencement of the Work.

1.6 INFORMATIONAL SUBMITTALS

- A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Use form acceptable to the Owner. Include the following information:
 - 1. Material category.
 - 2. Generation point of waste.
 - 3. Total quantity of waste in tons.
 - 4. Quantity of waste salvaged, both estimated and actual in tons.
 - 5. Quantity of waste recycled, both estimated and actual in tons.
 - 6. Total quantity of waste recovered (salvaged plus recycled) in tons.
 - 7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
- B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

1.7 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

1.8 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to ASTM E 1609 and requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of demolition and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.
- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
 1. Comply with operation, termination, and removal requirements in Section 015000 "Temporary Facilities and Controls."
- B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
 1. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
 2. All waste must be fully contained within steel roll-off containers and covered nightly.
 3. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

- A. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:
 1. Clean salvaged items.

2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
3. Store items in a secure area until installation.
4. Protect items from damage during transport and storage.
5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

B. Salvaged Items for Sale and Donation: Not permitted on Project site.

C. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

D. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.

E. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.

F. Lighting Fixtures: Separate lamps by type and protect from breakage.

G. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.

C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.

1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.
5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE

- A. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
- B. Metals: Separate metals by type.
 1. Structural Steel: Stack members according to size, type of member, and length.
 2. Remove and dispose of bolts, nuts, washers, and other rough hardware.
- C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.
- D. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.
- E. Metal Suspension System: Separate metal members including trim, and other metals from acoustical panels and tile and sort with other metals.
- F. Carpet: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.
 1. Store clean, dry carpet in a closed container or trailer provided by Carpet Reclamation Agency or carpet recycler.
- G. Carpet Tile: Remove debris, trash, and adhesive.
 1. Stack tile on pallet and store clean, dry carpet in a closed container or trailer provided by Carpet Reclamation Agency or carpet recycler.
- H. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.
- I. Conduit: Reduce conduit to straight lengths and store by type and size.

3.5 RECYCLING CONSTRUCTION WASTE

- A. Packaging:
 1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
 2. Polystyrene Packaging: Separate and bag materials.
 3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.

4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

- C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.

3.6 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

- B. Burning: Do not burn waste materials.

- C. Disposal: Remove waste materials from Owner's property and legally dispose of them.

- D. Special Note: See Section 011000 Summary for coordination with occupants and Owner's hours and dates of operations.

END OF SECTION 017419

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. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
- B. Related Sections:
 - 1. Section 017300 "Execution" for progress cleaning of Project site.
 - 2. Section 013233 "Photographic Documentation" for submitting final completion construction photographic documentation.
 - 3. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.
 - 4. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 5. Divisions 02 through 49 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.3 DEFINITIONS

- A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Architect's use prior to Architect's inspection, to determine if the Work is substantially complete.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of cleaning agent.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.5 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.

- C. Field Report: For pest-control inspection.

1.6 MAINTENANCE MATERIAL SUBMITTALS

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

1.7 SUBSTANTIAL COMPLETION 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 Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
 - 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. 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.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.
 - 5. Submit testing, adjusting, and balancing records.
 - 6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Advise Owner of pending insurance changeover requirements.
 - 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 - 3. Complete startup and testing of systems and equipment.
 - 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 - 5. 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."

6. Advise Owner of changeover in utility services.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements.
10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion 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. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. 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.

1.8 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:

1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.
5. Submit Final Completion photographic documentation.

B. 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. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.9 LIST OF INCOMPLETE ITEMS

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
 - 1. Organize list of spaces in sequential order, listed by room or space number.
 - 2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
 - 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Page number.
 - 4. Submit list of incomplete items in one of the following formats:
 - a. MS Excel Electronic File: Architect will return annotated file.
 - b. PDF Electronic File: Architect will return annotated file.
 - c. Web-Based Project Software Upload: Utilize software feature for creating and updating list of incomplete items (punch list).

1.10 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
 - 1. Submit by uploading to web-based project software site or by email to Architect.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site 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 not planted, mulched, or 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. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
 - i. Vacuum and mop concrete.
 - j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - k. 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.
 - l. Remove labels that are not permanent.
 - m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - p. Clean ducts, blowers, and coils.
 - q. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
 - r. Clean strainers.
 - s. 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.
- D. Construction Waste Disposal: Comply with waste-disposal requirements in Section 017419 "Construction Waste Management and Disposal."

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations required by Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

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. This 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. Systems and equipment operation manuals.
 - 4. Systems and equipment maintenance manuals.
 - 5. Product maintenance manuals.
- B. Related Sections include the following:
 - 1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
 - 2. Section 017700 "Closeout Procedures" for submitting operation and maintenance manuals.
 - 3. Section 017839 "Project Record Documents" for preparing Record Drawings for operation and maintenance manuals.
 - 4. Divisions 02 through 49 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

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. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect will comment on whether content of operation and maintenance submittals is acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

- B. Format: Submit operation and maintenance manuals in the following format:
 - 1. Submit by uploading to web-based project software site. Enable reviewer comments on draft submittals.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.
 - 1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.
- E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 - 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.
 - 1. Binders: Heavy-duty, three-ring, vinyl-covered, **[loose-leaf]** **[post-type]** 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. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 1. Title page.
 2. Table of contents.
 3. Manual contents.
- B. Title Page: Include the following information:
 1. Subject matter included in manual.
 2. Name and address of Project.
 3. Name and address of Owner.
 4. Date of submittal.
 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. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.7 EMERGENCY MANUALS

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

1.8 SYSTEMS AND EQUIPMENT OPERATION MANUALS

- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
 - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.

2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 2. Performance and design criteria if Contractor has delegated design responsibility.
 3. Operating standards.
 4. Operating procedures.
 5. Operating logs.
 6. Wiring diagrams.
 7. Control diagrams.
 8. Piped system diagrams.
 9. Precautions against improper use.
 10. License requirements including inspection and renewal dates.
- C. Descriptions: Include the following:
1. Product name and model number. Use designations for products indicated on Contract Documents.
 2. Manufacturer's name.
 3. Equipment identification with serial number of each component.
 4. Equipment function.
 5. Operating characteristics.
 6. Limiting conditions.
 7. Performance curves.
 8. Engineering data and tests.
 9. Complete nomenclature and number of replacement parts.
- D. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
 2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures.
- E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- F. Piped Systems: Diagram piping as installed and identify color coding where required for identification.

1.9 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
 - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.
- C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
 - 1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
 - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 - 3. Identification and nomenclature of parts and components.
 - 4. List of items recommended to be stocked as spare parts.
- E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 - 1. Test and inspection instructions.
 - 2. Troubleshooting guide.
 - 3. Precautions against improper maintenance.
 - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - 5. Aligning, adjusting, and checking instructions.
 - 6. Demonstration and training video recording, if available.

- F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
 - 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 - 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.
- J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
 - 1. Do not use original project record documents as part of maintenance manuals.

1.10 PRODUCT MAINTENANCE MANUALS

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Product Information: Include the following, as applicable:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Color, pattern, and texture.
 - 4. Material and chemical composition.
 - 5. Reordering information for specially manufactured products.

- E. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 - 1. Inspection procedures.
 - 2. Types of cleaning agents to be used and methods of cleaning.
 - 3. List of cleaning agents and methods of cleaning detrimental to product.
 - 4. Schedule for routine cleaning and maintenance.
 - 5. Repair instructions.
- F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
- H. Include procedures to follow and required notifications for warranty claims.

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.
- B. Related Requirements:
 - 1. Section 017300 "Execution" for final property survey.
 - 2. Section 017700 "Closeout Procedures" for general closeout procedures.
 - 3. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set(s) of marked-up record prints.
 - 2. Number of Copies: Submit copies of Record Drawings as follows:
 - a. Initial Submittal:
 - 1) Submit PDF electronic files of scanned record prints or Record Digital Data Files.
 - 2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit one paper-copy set(s) of marked-up record prints and Record Digital Data Files.
 - 2) Plot each drawing file, whether or not changes and additional information were recorded.
- B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and Contract modifications.

- C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.
 - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.
- E. Reports: Submit written report weekly indicating items incorporated into Project Record Documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

1.4 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 photographic documentation.
 - 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or 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 prints 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. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Annotated PDF electronic file with comment function enabled.
 2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 3. Refer instances of uncertainty to Architect for resolution.
 4. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.
 - a. See Section 013100 "Project Management and Coordination" for requirements related to use of Architect's digital data files.
 - b. Architect will provide data file layer information. Record markups in separate layers.
- C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Format: Annotated PDF electronic file with comment function enabled.
 3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.

1.5 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 annotated PDF electronic file.

1.6 RECORD PRODUCT DATA

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.

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

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

C. Format: Submit Record Product Data as annotated PDF electronic file.

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

1.7 MISCELLANEOUS RECORD SUBMITTALS

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

B. Format: Submit miscellaneous record submittals as PDF electronic file.

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

1.8 MAINTENANCE OF RECORD DOCUMENTS

A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

END OF SECTION 017839

SECTION 024113 – SELECTIVE SITE REMOVAL

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. This section covers the labor and materials necessary for the Work associated with the demolition of existing storm drainage and utility infrastructure, concrete, asphalt paving, and curb and gutter, etc. on the Drawings and specified herein while maintaining continuous operation of the Owner's facilities.
2. The information contained on Drawings showing demolition is based on the available record drawings and survey information within the project area. The supplementary information and reference drawings are provided solely for the convenience of the Contractor. Neither the Engineer nor the Owner assumes any responsibility for the accuracy or completeness of these drawings or for the Contractor's interpretation of this supplementary information. The Contractor shall perform all demolition required regardless of type or amount. The Contractor shall inspect the facilities to be demolished as specified in Specifications, to satisfy itself as to the nature and location of the Work. Differences between the Contract Documents and the actual facilities shall not constitute grounds for time extension or contract modifications.
3. Any utility to be relocated in order to facilitate construction should first be coordinated with the Owner or owning utility company before the utility is to be interrupted.

1.3 GENERAL

- A. Some obstructions may not be shown. This Contract shall include, as incidental to the Work, removal and replacement of obstructions such as water lines, electric lines, and similar items deemed by the Engineer to be required to meet the design intent shown in these Contract Documents, even though not shown or specifically mentioned.

1.4 DEFINITIONS

- A. Remove: Demolish complete as specified herein including offsite disposal except for those specific portions of removed items specified to be salvaged.
- B. Salvage: Detach and turn over to Owner removed portions of the Work in good working condition or credit the owner the price of the material or item.
- C. Standard Specifications: When referenced in this section, shall mean North Carolina Department of Transportation Road and Bridge Specifications, January 2012. Parts of these Standard Specifications that are specifically referenced shall become part of this section as though stated herein in full. In case of a discrepancy between the requirements of the Standard Specifications and the requirements stated herein, the requirements herein shall prevail.

1.5 MATERIALS OWNERSHIP

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

1.6 SUBMITTALS

- A. Submittals shall be made in accordance with the Division 01 Section “Submittal Procedures”. In addition, the following specific information shall apply:
 - 1. The Contractor shall submit to the Engineer for approval, schedules of demolition, including:
 - a. Detailed methods and phasing of demolition to be used within the project area including any interruption of existing utility services or access.
 - b. Copies of authorization, and permits, including any excavation permits, to remove the existing utility infrastructure as indicated on the Drawings.
 - c. Inventory of items to be removed and salvaged.
 - d. Pre-demolition photographs showing the existing conditions of adjoining construction and site improvements that might be misconstrued as damage cause by demolition operations.
 - e. Temporary protection measures
 - 2. The Contractor shall make all alterations in the schedule or methods required by the Engineer at the Contractor’s sole expense.
 - 3. No demolition activities shall commence until schedules for demolition have been approved by the Engineer and University representative for the affected areas or activities.

1.7 COORDINATION

- A. Prior to beginning demolition work, clearly field-identify all items that are scheduled to be demolished and salvaged.
- B. Conduct a walk-through with the Owner to:
 - 1. Verify and agree to the items identified for demolition and salvage.
 - 2. Identify and resolve problems with the existing utility infrastructure that will be a result of the demolition Work.
- C. Do not interrupt any service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Owner’s Representative no fewer than (72) hours in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of service without Owner’s Representative’s written permission.

PART 2 PRODUCTS - Not applicable to this Section

PART 3 EXECUTION

3.1 GENERAL

- A. The Contractor shall set up construction facilities in a neat and orderly manner in accordance with Specifications. Contractor shall accomplish all Work in accordance with the applicable portions of these Specifications and as approved. All operations shall be confined to the Work area.

3.2 PERFORMANCE REQUIREMENTS

- A. All Work shall be performed in conformance with local, State, and federal rules and regulations pertaining to safety and as specified elsewhere in these Specifications.
- B. Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Comply with ANSI A10.6 and NFPA 241.
- D. Contractor shall obtain all necessary local, State, and federal permits required for the demolition of the elements on site and complete all Work in conformance with local, State, and federal rules, including, but not limited to, New Hanover County, City of Wilmington, and NC requirements.

3.3 DISPOSAL AND SALVAGE OF MATERIAL

- A. Contractor shall remove and properly dispose of all rubble and material from the Site unless otherwise specified or shown on the Drawings. This shall include, but not be limited to, the following: concrete rubble, underdrain piping, storm drainage piping, unsuitable backfill material, fences, brush, wood, and other debris. Contractor shall accomplish disposal offsite in accordance with local, State, and federal laws.

3.4 DEMOLITION ACTIVITIES AND PROTECTION

- A. The Contractor shall be responsible for having all appropriate services located and turned off before demolition is started. The Contractor shall excavate all utility lines to be demolished and shall provide a permanent leak-proof closure for all abandoned water, gas lines, and electrical conduits. Closures shall be made with caps or plugs specifically designed for the applicable piping system.
- B. Where abandoned utility lines are exposed by demolition excavation, they shall be removed.
- C. Pipelines shall be sealed with plugs or caps of the same material as the line, with thrust restraint where applicable. Where plugs or caps are not available, abandoned lines shall be plugged with concrete to prevent groundwater infiltrating the abandoned lines. Work to be in accordance with Standard Specifications, see Construction Drawings for detail.
- D. Existing structures, boxes, pipes, and other items are to be removed, altered, re-located, salvaged, and / or disposed of as indicated on the Drawings or designated by the Engineer. All portions of these items that interfere with Work shall be removed and properly disposed.
- E. Existing pavement, curb, walks, and associated items shall be removed and disposed of as indicated on the Drawings or designated by the Engineer. When partially removing

pavement or curb, Contractor shall neatly saw cut at right angle to surface. All portions of these items that interfere with Work shall be removed and properly disposed.

- F. All portions of items designated to be removed shall be removed in the entirety and any resulting void shall be filled with compacted material, in accordance with Standard Specifications. The ends of abandoned pipes that are designated to be left in place shall be plugged, capped, or filled with concrete to provide a watertight seal as specified hereinbefore.
- G. The Contractor shall perform all Work in a manner that will not damage parts of the existing infrastructure not intended to be removed. If, in the opinion of the Engineer, the methods of removal, demolition, or cutting used may endanger or damage parts of the infrastructure or affect the satisfactory operation of the remaining infrastructure, the Contractor shall promptly change the method when notified by the Engineer. The Contractor shall examine the existing infrastructure and make a determination of required demolition and other conditions to be encountered in order to accomplish the Work. No blasting will be permitted for demolition activities.
- H. Repair and replacement of existing elements required due to Contractor activities shall be made at the Contractor's sole expense.

3.5 TEMPORARY PROTECTION MEASURES

- A. The Contractor shall perform all Work to prevent damage to all existing facilities and make all provisions necessary to protect the Owner's facilities from damage due the activities of the Contractor, including but not limited to, protection from dust, debris, water, humidity, and fumes.

3.6 SHUTDOWN OF EXISTING OPERATIONS AND UTILITIES

- A. Existing utilities including, but not limited to, water, gas, telecom, and other subsurface utilities, are required to remain in services during construction and modification of the new and existing infrastructure.
- B. All pedestrian, vehicular, and mobile equipment access shall be maintained during construction.
- C. Existing site lighting and security shall be maintained at equal or better conditions during construction.

END OF SECTION 024113

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 slabs.
- B. Related Sections:
 - 1. Division 32 for concrete pavement and walks.

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.
- D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - 1. Location of construction joints is subject to approval of the Architect.
- E. Samples: For vapor retarder.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Welding certificates.
- C. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Steel reinforcement and accessories.
 - 4. Curing compounds.
 - 5. Bonding agents.
 - 6. Adhesives.
 - 7. Vapor retarders.
 - 8. Semirigid joint filler.
 - 9. Joint-filler strips.
 - 10. Repair materials.
- D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
 - 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- E. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
- F. Field quality-control reports.
- G. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. 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.
- D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."

- E. 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."
- F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
 - 1. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
 - a. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
 - b. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- G. Preinstallation Conference: Conduct conference at Project site.
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.
 - e. Special concrete finish subcontractor.
 - 2. Review 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, 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.
 - 3. Review floor finishes to be installed and coordinate with curing methods to be used.

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 FORM-FACING MATERIALS

- A. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material.

Provide lumber dressed on at least two edges and one side for tight fit.

- B. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- C. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

2.3 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:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.4 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. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class F.
- B. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
 - 1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94/C 94M and potable.

2.5 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.
- C. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494/C 494M, Type C.
1. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Axim Italcementi Group, Inc.; CATEXOL CN-CI
 - b. BASF Construction Chemicals - Building Systems; Rheocrete CNI
 - c. Euclid Chemical Company (The), an RPM company; ARRMATECT, EUCON BCN, or EUCON CIA
 - d. Grace Construction Products, W. R. Grace & Co.; DCI
 - e. Sika Corporation; Sika CNI
- D. Synthetic Macro-Fiber: Polyolefin macro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, 1 to 2-1/4 inches (25 to 57 mm) long.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Euclid Chemical Company (The), an RPM company; Tuf-Strand SF.
 - b. FORTA Corporation; FORTA FERRO.
 - c. Grace Construction Products, W. R. Grace & Co.; Strux 90/40.
 - d. Nycon, Inc.; XL.
 - e. Propex Concrete Systems Corp.; Fibermesh 650.
 - f. Sika Corporation; Sika Fiber MS.

2.6 VAPOR RETARDERS

- A. Sheet Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape. Maximum perm rating of 0.02.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fortifiber Building Systems Group; Moistop Ultra 15
 - b. Grace Construction Products, W. R. Grace & Co.; Florprufe 120
 - c. Insulation Solutions, Inc.; Viper VaporCheck II
 - d. Meadows, W. R., Inc.; Perminator 15 mil
 - e. Raven Industries Inc.; Vapor Block 15
 - f. Reef Industries, Inc.; Griffolyn 15 mil Green
 - g. Stego Industries, LLC; Stego Wrap 15 mil Class A
 2. Provide manufacturer's compatible sealer system for penetrations.
- B. Granular Fill: Provide one of the following:
- a. Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

- b. Clean sands with less than 3 percent fines. Materials to be verified by a qualified Geotechnical Engineer.

2.7 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Construction Chemicals - Building Systems; Confilm
 - b. ChemMasters; SprayFilm
 - c. Conspec by Dayton Superior; Aquafilm
 - d. Dayton Superior Corporation; Sure Film (J-74)
 - e. Euclid Chemical Company (The), an RPM company; Eucobar
 - f. L&M Construction Chemicals, Inc.; E-CON
 - g. Meadows, W. R., Inc.; EVAPRE
 - h. Sika Corporation; SikaFilm
 - i. Symons by Dayton Superior; Finishing Aid
 - j. Unitex; PRO-FILM
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anti-Hydro International, Inc.; AH Clear Cure WB
 - b. BASF Construction Chemicals - Building Systems; Kure-N-Seal WB
 - c. ChemMasters; Safe-Cure & Seal 20
 - d. Conspec by Dayton Superior; Cure and Seal WB
 - e. Cresset Chemical Company; Crete-Trete 309-VOC Cure & Seal
 - f. Dayton Superior Corporation; Safe Cure and Seal (J-18)
 - g. Euclid Chemical Company (The), an RPM company; Aqua Cure VOX; Clearseal WB 150
 - h. L&M Construction Chemicals, Inc.; Dress & Seal WB
 - i. Meadows, W. R., Inc.; Vocomp-20
 - j. Symons by Dayton Superior; Cure & Seal 18 Percent E

2.8 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. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. 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.

2.9 REPAIR MATERIALS

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

2.10 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash: 25 percent.

2. Combined Fly Ash and Pozzolan: 25 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
 1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
 4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.11 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Footings: Proportion normal-weight concrete mixture as follows:
 1. Minimum Compressive Strength: 3000 psi at 28 days.
 2. Slump Limit: 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
- B. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:
 1. Minimum Compressive Strength – typical interior slab: 3000 psi at 28 days.
 2. Minimum Compressive Strength – typical exterior slab: 4000 psi (27.6 MPa) at 28 days.
 3. Slump Limit: 4 inches, plus or minus 1 inch.
 4. Air Content: For exterior broom finished concrete only; 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.
 5. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.
 6. Synthetic Macro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 3.0 lb/cu. yd. (1.5 kg/cu. m).
- C. Suspended Slabs: Proportion normal-weight concrete mixture as follows:
 1. Minimum Compressive Strength: 3000 psi (20.7 MPa) at 28 days.
 2. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).
 3. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

2.12 FABRICATING REINFORCEMENT

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

2.13 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 FORMWORK

- A. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- B. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
 1. Class A, 1/8 inch (3.2 mm) for smooth-formed finished surfaces.
- C. Construct forms tight enough to prevent loss of concrete mortar.
- D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 1. Install keyways, reglets, recesses, and the like, for easy removal.
 2. Do not use rust-stained steel form-facing material.
- E. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- F. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- G. Chamfer exterior corners and edges of permanently exposed concrete.
- H. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- I. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- J. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- K. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 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."

3.3 VAPOR RETARDERS

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
 - 1. Following leveling and tamping of granular base for slabs on grade, place vapor barrier sheeting with longest dimension parallel with direction of pour and face laps away from the expected direction of the placement whenever possible.
 - 2. Extend vapor barrier to the perimeter of the slab. If practicable, terminate it at the top of the slab, otherwise (a) at a point acceptable to the structural engineer or (b) where obstructed by impediments, such as dowels, waterstops, or any other site condition requiring early termination of the vapor barrier. At the point of termination, seal vapor barrier to the foundation wall, grade beam or slab itself.
 - 3. Lap joints 6 inches and seal with manufacturer's recommended tape.
 - 4. Apply seam tape to a clean and dry vapor barrier.
 - 5. Seal all penetrations (including pipes) per manufacturer's instructions.
 - 6. Avoid the use of non-permanent stakes driven through vapor retarder.
 - 7. If non-permanent stakes are driven through vapor retarder, repair as recommended by vapor retarder manufacturer.
 - 8. Repair damaged areas with vapor barrier material of similar (or better) permeance, puncture and tensile.

3.4 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.
 - 1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with

wire.

3.5 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 - 3. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action 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. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
 - 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.6 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. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete 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.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Maintain reinforcement in position on chairs during concrete placement.
 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 4. Slope surfaces uniformly to drains where required.
 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- F. 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.
- G. 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.

3.7 FINISHING FORMED SURFACES

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

3.8 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 indicated and 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 indicated 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 exposed to view or 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) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.

- 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.

3.9 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.10 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:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies 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.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

3.11 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 1. Defer joint filling until concrete has aged at least one month. 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.

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

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

3.13 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
 - 1. Steel reinforcement placement.
 - 2. Steel reinforcement welding.
 - 3. Headed bolts and studs.
 - 4. Verification of use of required design mixture.
 - 5. Concrete placement, including conveying and depositing.
 - 6. Curing procedures and maintenance of curing temperature.
 - 7. Verification of concrete strength before removal of shores and forms from beams and slabs.
- D. 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: Samples for strength tests of each class of concrete placed each day shall be taken not less than once a day, nor less than once for each 50 cu. yd. (114 cu. m) of concrete, nor less than once for each 5,000 sq. ft. of surface area for slabs or walls.
 - 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. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - 6. Compression Test Specimens: ASTM C 31/C 31M.
 - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
 - 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.
- E. Measure floor and slab flatness and levelness according to ASTM E 1155 within 48 hours of finishing.

END OF SECTION 033000

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. Composite floor deck.
- B. Related Requirements:
 - 1. Section 033000 "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
 - 2. Division 051200 Section "Structural Steel Framing" for shop- and field-welded shear connectors.
 - 3. 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: Based on evaluation of comprehensive 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.

- E. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."
- C. FM Global Listing: Provide steel roof deck evaluated by FM Global and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

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."
- B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified 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 COMPOSITE FLOOR DECK

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ASC Profiles, Inc.; a Blue Scope Steel company.
 - 2. Canam United States; Canam Group Inc.
 - 3. CMC Joist & Deck.
 - 4. Consolidated Systems, Inc.; Metal Dek Group.
 - 5. Cordeck.

6. DACS, Inc.
7. Epic Metals Corporation.
8. Marlyn Steel Decks, Inc.
9. New Millennium Building Systems, LLC.
10. Nucor Corp.; Vulcraft Group.
11. Roof Deck, Inc.
12. Verco Manufacturing Co.
13. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

- B. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 (230), G60 (Z180) zinc coating.
 2. Profile Depth: 2 inches (51 mm).
 3. Design Uncoated-Steel Thickness: 0.0358 inch (0.91 mm).
 4. Span Condition: As indicated.

2.3 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 (4.8-mm) minimum diameter.
- D. 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 FLOOR-DECK INSTALLATION

- A. Fasten floor-deck panels to steel supporting members as follows:
 - 1. No. 12 self-tapping screws.
 - 2. Screw Spacing: 12" on center.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of half of the span or 36 inches (914 mm), and as follows:
 - 1. Mechanically fasten with self-drilling, No. 10 (4.8-mm-) 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 (38 mm), with end joints as follows:
 - 1. End Joints: Lapped or butted at Contractor's option.
- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.

3.4 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.

3.5 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 Substantial Completion.

END OF SECTION 053100

SECTION 054000 - COLD-FORMED 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. Exterior non-load-bearing wall framing.
 - 2. Interior load-bearing wall framing.
 - 3. Soffit framing.
- B. Related Requirements:
 - 1. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies.
 - 2. Section 092216 "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.
 - 1. Design Loads: As indicated.
 - 2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/240 of the wall height.
 - b. Interior Load-Bearing Wall Framing: Horizontal deflection of 1/240 of the wall height under a horizontal load of 5 lbf/sq. ft. (239 Pa).
 - c. Ceiling Joist Framing: Vertical deflection of 1/360 of the span.
 - 3. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F (67 deg C).
 - 4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
 - a. Upward and downward movement of 3/4 inch (19 mm).

- B. Cold-Formed Steel Framing, General: Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."
 - 1. Headers: Design according to AISI's "Standard for Cold-Formed Steel Framing - Header Design."
 - 2. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

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.
- C. Delegated-Design Submittal: For cold-formed steel framing.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Welding certificates.
- C. Product Test Reports: For each listed product, for tests performed by manufacturer and witnessed 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.
- D. Research Reports: For non-standard cold-formed steel framing, from ICC-ES.

1.6 QUALITY ASSURANCE

- A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.
- B. 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 cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.

- C. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- D. 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.
- E. 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."
- F. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
- G. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."
 - 1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Truss Design."
 - 2. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."
- H. Preinstallation Conference: Conduct conference at Project site.

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 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. AllSteel & Gypsum Products, Inc.
 - 2. California Expanded Metal Products Company.
 - 3. ClarkWestern Building Systems, Inc.
 - 4. Consolidated Fabricators Corp.; Building Products Division.
 - 5. Craco Mfg., Inc.
 - 6. Custom Stud Inc.
 - 7. Design Shapes in Steel.
 - 8. Dietrich Metal Framing; a Worthington Industries Company.
 - 9. Formetal Co. Inc. (The).
 - 10. MarinoWARE.

11. Nuconsteel; a Nucor Company.
12. Olmar Supply, Inc.
13. Quail Run Building Materials, Inc.
14. SCAFCO Corporation.
15. Southeastern Stud & Components, Inc.
16. State Building Products, Inc.
17. Steel Construction Systems.
18. Steel Network, Inc. (The).
19. Steel Structural Systems.
20. Steeler, Inc.
21. Super Stud Building Products, Inc.
22. Telling Industries, LLC.
23. United Metal Products, Inc.
24. United Steel Manufacturing.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.
- B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
 1. Design Loads: As indicated.
 2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/240 of the wall height.
 3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F (67 deg C).
 4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
 - a. Upward and downward movement of 3/4 inch (19 mm).
 5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
- C. Cold-Formed Steel Framing Design Standards:
 1. Wall Studs: AISI S211.
 2. Headers: AISI S212.
 3. Lateral Design: AISI S213.
- D. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.

- E. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.3 MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
 - 1. Grade: As required by structural performance.
 - 2. Coating: G60 (Z180).
- C. Steel Sheet for Vertical Deflection Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
 - 1. Grade: As required by structural performance.
 - 2. Coating: G60 (Z180).

2.4 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: 0.0428 inch (1.87 mm).
 - 2. Flange Width: As required by design.
 - 3. Section Properties: As required by design.
- B. Steel Track: Sigma Track by The Steel Network or approved equal, of web depths indicated, unpunched, with straight flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 18 gauge minimum or match steel studs.
 - 2. Flange Width: 1-1/2 inches.
- C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, punched, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0428 inch (1.87 mm).
 - 2. Flange Width: As required by design..
 - 3. Section Properties: As required by design.
- D. Steel Double-L Headers: Manufacturer's standard L-shapes used to form header beams, of web depths indicated, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0428 inch (1.87 mm).
 - 2. Top Flange Width: As required by design.

3. Section Properties: As required by design.

2.5 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: 0.0428 inch (1.09 mm).
 2. Flange Width: 1-5/8 inches (41 mm).
 3. Section Properties: Minimum allowable calculated section modulus = 0.772 in³, moment of inertia = 2.316 in⁴, and allowable moment = 16767 in-lbs.
- 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: Matching steel studs.
 2. Flange Width: 1-1/4 inches (32 mm).
- C. Vertical Deflection Clips: Manufacturer's standard head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. AllSteel & Gypsum Products, Inc.
 - b. ClarkWestern Building Systems, Inc.
 - c. Dietrich Metal Framing; a Worthington Industries company.
 - d. MarinoWARE.
 - e. SCAFCO Corporation.
 - f. Steel Network, Inc. (The).
 - g. Steeler, Inc.
- D. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
 1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
 - a. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
 - b. Flange Width: 1 inch (25 mm) plus the design gap of 3/4 inch.
 2. Inner Track: Of web depth indicated, and as follows:
 - a. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
 - b. Flange Width: 2 ¾ inches.

2.6 SOFFIT FRAMING

- A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
 2. Flange Width: 1-5/8 inches (41 mm), minimum.
 3. Section Properties: Minimum allowable calculated section modulus = 0.380 in³, moment of inertia = 0.697 in⁴, and allowable moment = 7502 in-lbs.

2.7 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.

2.8 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. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.
- 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 E 488 conducted by a qualified testing agency.
- D. 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.

- E. 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.
- F. Welding Electrodes: Comply with AWS standards.

2.9 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B.
- B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107/C 1107M, with fluid consistency and 30-minute working time.
- D. Shims: Load bearing, high-density multimonomer plastic, and nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.
- E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.10 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, bolting, 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 (1:960) and as follows:
 - 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) 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 (3 mm).

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, bolt, 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 (1.6 mm).
- 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. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
- H. 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.
- I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.
- J. 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 (1:960) and as follows:
 - 1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.3 LOAD-BEARING WALL INSTALLATION

- A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:
 - 1. Anchor Spacing: As shown on Shop Drawings.
- B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/16 inch between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:
 - 1. Stud Spacing: 16 inches (406 mm).
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.
- D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.
- E. Align floor and roof framing over studs. Where framing cannot be aligned, continuously reinforce track to transfer loads.
- F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.
- G. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.

1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings. Fasten jamb members together to uniformly distribute loads.
 2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.
- H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.
1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.
- I. Install horizontal bridging in stud system, spaced 48 inches (1220 mm). Fasten at each stud intersection.
1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of 2 screws into each flange of the clip angle for framing members up to 6 inches (150 mm) deep.
 2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 3. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- J. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.4 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 double deep-leg deflection tracks and anchor outer track to building structure.
 2. Connect vertical deflection clips to infill 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 (1220 mm) apart. Fasten at each stud intersection.

1. 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.

3.5 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.

3.6 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. Preassembled steel stairs with concrete-filled or precast concrete treads.
2. Steel pipe and tube railings.
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.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.

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 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. 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.

D. 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.

- E. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Manufacturer's product lines of mechanically connected railings.
 - 2. Railing brackets.
 - 3. Grout, anchoring cement, and paint products.
- 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 mechanical and electrical equipment.
 - 2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 - 3. Steel Stairs:
 - a. Include plans, elevations, sections, details, and attachments to other work.
 - b. Indicate sizes of metal sections, thickness of metals, profiles, holes, and field joints.
 - c. Include plan at each level.
 - d. Indicate locations of anchors, weld plates, and blocking for attachment of wall-mounted handrails.
- C. Delegated-Design Submittal: For stairs, railings and guards, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer.
- B. Mill Certificates: Signed by stainless-steel manufacturers, certifying that products furnished comply with requirements.
- C. Welding certificates.
- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- E. Research/Evaluation Reports: For post-installed anchors, from ICC-ES.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - 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.

1.8 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.
 4. Repair or replace damaged materials or structures as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings and ladders.
- B. Structural Performance of Stairs: Metal stairs shall 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.
- C. Structural Performance of Railings and Guards: Railings and guards, including attachment to building construction, shall 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.

- D. 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.
- E. Seismic Performance of Stairs: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. Component Importance Factor: See structural drawings.

2.2 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. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
 - 1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.
- C. Steel Tubing for Railings and Guards: ASTM A500/A500M (cold formed) or ASTM A513/A513M.
- D. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- E. Uncoated, Hot-Rolled Steel Sheet: ASTM A1011/A1011M, either commercial steel, Type B, or structural steel, Grade 30, unless another grade is required by design loads.

2.3 STEEL AND IRON

- A. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
 - 1. Provide galvanized finish for exterior installations and where indicated.
- B. Plates, Shapes, and Bars: ASTM A 36/A 36M.

2.4 ABRASIVE NOSINGS

- A. Cast-Metal Units: Cast iron, aluminum, bronze, or nickel silver, with an integral abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both. Fabricate units in lengths necessary to accurately fit openings or conditions.
 - 1. Configuration: Cross-hatched units, 3 inches wide without lip.
- B. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.

- C. Apply bituminous paint to concealed surfaces of cast-metal units set into concrete.

2.5 FASTENERS

- A. General: Provide the following:

- 1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 for zinc coating.

- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

- C. Fasteners for Interconnecting Railing Components:

- 1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.

- D. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.

- 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.

- 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.

- I. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

2.6 MISCELLANEOUS MATERIALS

- A. Handrail Wall Brackets: Cast nickel-silver, center of rail 2-1/2 inches from face of wall.

- 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. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- F. Non-shrink, Nonmetallic Grout: Factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.7 PRECAST CONCRETE TREADS (OPTIONAL)

- A. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, ready-mixed concrete with a minimum 28-day compressive strength of 5000 psi and a total air content of not less than 4 percent or more than 6 percent.
- B. Reinforcement: Galvanized, welded-wire reinforcement, 2 by 2 inches by 0.062-inch-diameter steel wire; comply with ASTM A1064/A1064M, except for minimum wire size.

2.8 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. 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.
- D. 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.
- E. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

- F. Form exposed work with accurate angles and surfaces and straight edges.
- G. 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.
- H. 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.
- I. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- J. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- K. 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.
- L. 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.

2.9 FABRICATION OF STEEL-FRAMED STAIRS

- A. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for Commercial Class, unless more stringent requirements are indicated.
- B. Stair Framing:
 - 1. Fabricate stringers of steel plates.
 - a. Stringer Size: As required to comply with "Performance Requirements" Article.
 - b. Provide closures for exposed ends of channel and rectangular tube stringers.
 - c. Finish: Shop primed.
 - 2. Construct platforms of steel plate or channel headers and miscellaneous framing members as required to comply with "Performance Requirements" Article.
 - 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.
 - a. Locate hanger rods and struts where they do not encroach on required stair width and are within the fire-resistance-rated stair enclosure.
- 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. Steel Sheet: Uncoated, hot-rolled steel sheet.
 2. 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.
 3. Shape metal pans to include nosing integral with riser.
 4. At Contractor's option, provide stair assemblies with metal pan subtreads filled with reinforced concrete during fabrication.
 5. 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.

2.10 FABRICATION OF RAILINGS AND GUARDS

- A. General: Fabricate railings and guards to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Shop assemble railings and guards to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. 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.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with welded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 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 flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Form Changes in Direction as Follows:

1. By bending or by inserting prefabricated elbow fittings.

J. 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.

K. Close exposed ends of railing members with prefabricated end fittings.

L. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.

M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

O. For railing posts set in concrete, provide stainless-steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.

P. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.11 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. Galvanize miscellaneous framing and supports where indicated.

D. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.12 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.

2.13 FINISHES, GENERAL

- A. Finish metal stairs and metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.14 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 not indicated to be galvanized 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 requirements indicated below:
 - 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 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, 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. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
 - 1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.
- D. 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.
- E. 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.
- F. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.3 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.
- 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."
 - 1. Install abrasive nosings with anchors fully embedded in concrete.
 - 2. Center nosings on tread width.
- G. Install precast concrete treads with adhesive supplied by manufacturer.

3.4 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 or bolting 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. Install railing gates level, plumb, and secure for full opening without interference.
 - 1. Attach hardware using tamper-resistant or concealed means.
 - 2. Adjust hardware for smooth operation.
- C. 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.

3.5 ANCHORING POSTS

- A. Use metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
- C. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material.
- D. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
 - 1. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.
- E. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.6 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.

3.7 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.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

3.8 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 055000

SECTION 061053 - MISCELLANEOUS 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, cants, and nailers.
 - 2. Wood furring.
 - 3. 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 or greater size 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 D 5664.
 - 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. Evaluation Reports: For the following, from ICC-ES:
 - 1. Preservative-treated wood.
 - 2. Fire-retardant-treated wood.
 - 3. Power-driven fasteners.

4. Post-installed anchors.
5. Metal framing anchors.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

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, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded 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 for 2-inch nominal thickness or less, 19 percent for more than 2-inch nominal thickness unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWPAC 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.
 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 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 all miscellaneous carpentry unless otherwise indicated.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
 - 1. Treatment shall not promote corrosion of metal fasteners.
 - 2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
 - 3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
 - 4. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D 5664, and design value adjustment factors shall be calculated according to ASTM D 6841. For enclosed roof framing, framing in attic spaces, and where high-temperature fire-retardant treatment is indicated, provide material with adjustment factors of not less than 0.85 modulus of elasticity and 0.75 for extreme fiber in bending for Project's climatological zone.
- C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
- E. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not bleed through, contain colorants, or otherwise adversely affect finishes.
- F. Application: Treat all miscellaneous carpentry unless otherwise indicated.

2.4 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. Cants.
 - 4. Furring.
 - 5. Grounds.
 - 6. Utility shelving.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of any of the following species:

1. Mixed southern pine or southern pine; SPIB.
2. Spruce-pine-fir; NLGA.
3. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
4. Western woods; WCLIB or WWPA.
5. Eastern softwoods; NeLMA.

C. Concealed Boards: 15 percent maximum moisture content of the following species and grades:

1. Mixed southern pine or southern pine, No. 2 grade; SPIB.

D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.5 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

2.6 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where 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 A 153/A 153M.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Screws for Fastening to Metal Framing: ASTM C 1002, length as recommended by screw manufacturer for material being fastened.

D. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

E. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 ICC-ES AC193 as appropriate for the substrate.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

2.7 METAL FRAMING ANCHORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cleveland Steel Specialty Co.
 - 2. KC Metals Products, Inc.
 - 3. Phoenix Metal Products, Inc.
 - 4. Simpson Strong-Tie Co., Inc.
 - 5. USP Structural Connectors.
- B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.
 - 1. Use for interior locations unless otherwise indicated.
- C. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.
 - 1. Use for wood-preservative-treated lumber and where indicated.

2.8 MISCELLANEOUS MATERIALS

- A. Adhesives for Gluing Furring to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.
- B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spun-bonded polyolefin to produce an overall thickness of not less than 0.025 inch.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.
- D. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- E. Do not splice structural members between supports unless otherwise indicated.

- F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
 - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.
- G. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities.
- H. 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.
- I. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
 - 1. Use inorganic boron for items that are continuously protected from liquid water.
 - 2. Use copper naphthenate for items not continuously protected from liquid water.
- J. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- K. Securely attach 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.
 - 2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
 - 3. ICC-ES evaluation report for fastener.
- L. Use steel common 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 between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

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.

3.3 WOOD FURRING INSTALLATION

- A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

3.4 PROTECTION

- A. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061053

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. This Section includes the following:
 - 1. Wall sheathing.
- B. Related Sections include the following:
 - 1. Division 06 Section "Miscellaneous Rough Carpentry" for plywood backing panels.
 - 2. Division 07 Section "Fluid-Applied Membrane Air Barriers" for air barriers.

1.3 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Stack panels flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WALL SHEATHING AND EXTERIOR SOFFITS

- A. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. Georgia-Pacific Gypsum LLC.
 - c. National Gypsum Company.
 - d. USG Corporation.
 - 2. Basis of Design Product: Subject to compliance with requirements, provide "Dens-Glass Gold" by G-P Gypsum Corporation.
 - 3. Type and Thickness: Regular, 5/8 inch thick.

2.2 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
 - 1. For roof sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing board to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.
 - 1. For steel framing less than 0.0329-inch-thick, attach sheathing to comply with ASTM C 1002.
 - 2. For steel framing from 0.033 to 0.112-inch-thick, attach sheathing to comply with ASTM C 954.

2.3 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Framing: Formulation complying with APA AFG-01 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

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.
- 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. NES NER-272 for power-driven fasteners.
 - 2. Table 2304.9.1, "Fastening Schedule," in 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. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

- F. 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 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 boards with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
 - 3. Install boards 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 boards but do not cut into facing.
- C. Vertical Installation: Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board 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 boards.

END OF SECTION 061600

SECTION 064116 - PLASTIC-LAMINATE-FACED 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-faced architectural cabinets.
- 2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-faced architectural cabinets unless concealed within other construction before cabinet installation.

B. Related Requirements:

- 1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets and concealed within other construction before cabinet installation.
- 2. Section 123661.16 "Solid Surfacing Countertops".

1.3 ACTION SUBMITTALS

- A. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

- 1. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
- 2. Show locations and sizes of cutouts and holes for installed in architectural plastic-laminate cabinets.

B. Samples for Verification:

- 1. Plastic laminates for each type, color, pattern, and surface finish.
- 2. Lumber and Panel Products with Transparent Finish: Not less than 5 inches wide by 12 inches long, for each species and cut, finished on one side and one edge.
- 3. Exposed cabinet hardware and accessories, one unit for each type and finish.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

- B. Product Certificates: For each type of product.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that 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.
- B. Installer Qualifications: Fabricator of products.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver cabinets until painting and similar operations that could damage woodwork have been completed in installation areas. If cabinets must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.7 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 between 60 and 90 deg F and relative humidity between 25 and 55 percent 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, 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.

1.8 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that cabinets can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

- A. Type of Construction: Frameless.
- B. Cabinet, Door, and Drawer Front Interface Style: Flush overlay.
- C. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Abet Laminati, Inc.
 - b. Formica Corporation.
 - c. Lamin-Art, Inc.
 - d. Panolam Industries International, Inc.
 - e. Wilsonart International; Div. of Premark International, Inc.

D. Laminate Cladding for Exposed Surfaces:

1. Horizontal Surfaces: Grade HGS.
2. Postformed Surfaces: Grade HGP.
3. Vertical Surfaces: Grade VGS.
4. Edges: Grade VGS.

E. Materials for Semi-exposed Surfaces:

1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade VGS.
 - a. Edges of Plastic-Laminate Shelves: PVC edge banding, 0.12-inch-thick, matching laminate in color, pattern, and finish.
 - b. For semi-exposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade VGS.
2. Drawer Sides and Backs: Thermoset decorative panels with PVC or polyester edge banding.
3. Drawer Bottoms: Hardwood plywood.

F. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.

G. Drawer Construction: Fabricate with exposed fronts fastened to sub-front 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.

H. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. Selected by Architect from manufacturer's standard range.

2.2 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Wood Moisture Content: 8 to 13 percent.

- B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
 - 1. Recycled Content of Medium-Density Fiberboard and Particleboard: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 50 percent.
 - 2. Medium-Density Fiberboard: ANSI A208.2, Grade 130, made with binder containing no urea formaldehyde.
 - 3. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde.
 - 4. Softwood Plywood: DOC PS 1, medium-density overlay.
 - 5. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, made with adhesive containing no urea formaldehyde.
 - 6. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.3 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.
- B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 135 degrees of opening, self-closing.
- C. Wire Pulls: Back mounted, solid metal, 4 inches long, 5/16 inch in diameter.
- D. Catches: Magnetic catches, BHMA A156.9, B03141.
- E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.
- F. Drawer Slides: BHMA A156.9.
 - 1. Grade 1 and Grade 2: Side mounted; full-extension type; zinc-plated 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 2.
 - 4. For drawers more than 3 inches high but not more than 6 inches high and not more than 24 inches wide, provide Grade 1.
 - 5. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1HD-100.
 - 6. For computer keyboard shelves, provide Grade 1.
 - 7. For trash bins not more than 20 inches high and 16 inches wide, provide Grade 1HD-100.
- G. Door and Drawer Silencers: BHMA A156.16, L03011.
- H. 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.

- I. 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. Adhesives: Do not use adhesives that contain urea formaldehyde.
- D. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.
 1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.5 FABRICATION

- A. Fabricate 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.
- 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 average prevailing humidity conditions in installation areas.
- B. Before installing cabinets, examine shop-fabricated work for completion and complete work as required.

3.2 INSTALLATION

- A. Assemble cabinets and complete fabrication at Project site to the extent that it was not completed in the shop.
- B. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

- C. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish.
- D. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
 - 1. Use filler matching finish of items being installed.
- E. Cabinets: Install without distortion so doors and drawers fit openings properly 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.
 - 1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 - 2. 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.
- F. Shop Finishes: Touch up finishing after installation of architectural cabinets. Fill nail holes with matching filler.
 - 1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware. Clean cabinets on exposed and semi-exposed surfaces.

END OF SECTION 064116

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. Extruded polystyrene foam-plastic board.
- 2. Glass-fiber blanket.
- 3. Mineral-wool blanket.

B. Related Requirements:

- 1. Section 133419 " Metal Building Systems" for insulation installed in roof and exterior purlin walls.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

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

1.5 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

- A. Extruded Polystyrene Board, Type IV: ASTM C578, Type IV, 25-psi minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E84.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DiversiFoam Products.

- b. Dow Chemical Company (The).
- c. Owens Corning.

2.2 GLASS-FIBER BLANKET

- A. Glass-Fiber Blanket, Unfaced: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Owens Corning.
 - 2. Thermal Values: R13, R19 and R30.
 - a. See Drawings for wall types and wall sections for locations.

2.3 MINERAL-WOOL BLANKETS

- A. Mineral-Wool Blanket, Unfaced: ASTM C665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E84; passing ASTM E136 for combustion characteristics.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. Rockwool International.
 - c. Thermafiber, Inc.; an Owens Corning company.
 - 2. Locations: See wall types and wall sections for locations.

2.4 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
 - 1. Glass-Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E84.
 - 2. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 - 4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
- B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
 - 1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb./cu. ft.
 - 2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.
- C. Loose-Fill Insulation: Apply according to ASTM C1015 and manufacturer's written instructions. Level horizontal applications to uniform thickness as indicated, lightly settle to uniform density, but do not compact excessively.

3.4 INSTALLATION OF INSULATION IN CEILING CONSTRUCTION

- A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the area above the ceiling tile. If more than one length is required to fill the area, provide lengths that will produce a snug fit between ends.
 - 2. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
- B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
 - 1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb./cu. ft.

3.5 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 072726 - FLUID-APPLIED MEMBRANE AIR 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 fluid-applied, air and vapor barrier membranes.
- B. Related Requirements:
 - 1. Section 061600 "Sheathing" for wall sheathings and wall sheathing joint-and-penetration treatments.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of products.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.
- C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Mockups: See Section 042000 for information regarding the construction of mockups.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- B. Protect stored materials from direct sunlight.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air-barrier manufacturer.
 - 1. Protect substrates from environmental conditions that affect air-barrier performance.
 - 2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.
- B. VOC Content: 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and complying with VOC content limits of authorities having jurisdiction.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Air barrier shall be capable of performing as a continuous vapor-retarding 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.

2.3 VAPOR-IMPERMEABLE MEMBRANE AIR-BARRIER

- A. Fluid-Applied, Air and Vapor Barrier: synthetic polymer membrane.
 - 1. Basis of Design Products: Subject to compliance with requirements, provide Henry Company Air-Bloc 16MR Air and Vapor Barrier or a comparable product by one of the following manufacturers:
 - a. Carlisle Coatings & Waterproofing Inc.
 - b. GCP Applied Technologies Inc. (formerly Grace Construction Products).
 - c. Hohmann & Barnard, Inc.
 - d. Rubber Polymer Corporation, Inc.
 - e. W. R. Meadows, Inc.
 - 2. Physical and Performance Properties:
 - a. Water Vapor Permeance (ASTM E96 Method A): 0.03 perms
 - b. Air Leakage of Air Barrier Assemblies (ASTM E2357): Pass
 - c. Air Permeance (ASTM E2178): Pass
 - d. Elongation (ASTM D412): 270%
 - e. Tensile Strength (ASTM D412): 100 psi (689 kPa)
 - f. Minimum Application Temperature: 20 degrees F (-6 degrees C)
 - g. Water Penetration Resistance Around Nails (ASTM D1970): Pass

- h. Maximum VOC: 68 g/l

2.4 ACCESSORY MATERIALS

- A. General: Accessory materials recommended by air-barrier manufacturer to produce a complete air-barrier assembly and compatible with primary air-barrier material.
- B. Primer: Liquid primer recommended for substrate by air-barrier material manufacturer.
- C. Substrate-Patching Membrane: Manufacturer's standard trowel-grade substrate filler.
- D. Adhesive and Tape: Air-barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.
- E. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, 0.0187-inch-thick, and Series 300 stainless-steel fasteners.
- F. Self-Adhered Flashing: Non-vapor permeable, self-adhered water resistive air and vapor barrier consisting of an SBS rubberized asphalt compound integrally laminated to a thermoplastic film surface; having the following typical physical properties:
 - 1. Thickness: 40 mils
 - 2. Water Vapor Permeance (ASTM E96): 0.86 perms
 - 3. Nail Sealability (ASTM D1970): Pass
 - 4. Elongation (ASTM D412-modified): 200% minimum
 - 5. Low Application Temperature: 41 degrees F (5 degrees C)
- G. Joint Sealant: ASTM C 920, single-component, neutral-curing silicone; Class 100/50 (low modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O. Comply with Section 079200 "Joint Sealants."
- H. Termination Mastic: Air-barrier manufacturer's standard cold fluid-applied elastomeric liquid; trowel grade.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
 - 1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
 - 2. Verify that concrete has cured and aged for minimum time period recommended by air-barrier manufacturer.
 - 3. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
 - 4. Verify that masonry joints are flush and completely filled with mortar.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air-barrier application.
- B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.
- E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.
- G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.3 JOINT TREATMENT

- A. Concrete and Masonry: Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1193 and air-barrier manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D 4258 before coating surfaces.
 - 1. Prime substrate and apply a single thickness of air-barrier manufacturer's recommended preparation coat extending a minimum of 3 inches along each side of joints and cracks. Apply a double thickness of fluid air-barrier material and embed a joint reinforcing strip in preparation coat.
- B. Gypsum Sheathing: Fill joints greater than 1/4 inch with sealant according to ASTM C 1193 and air-barrier manufacturer's written instructions. Apply first layer of fluid air-barrier material at joints. Tape joints with joint reinforcing strip after first layer is dry. Apply a second layer of fluid air-barrier material over joint reinforcing strip.

3.4 INSTALLATION

- A. Temperature limitation:
 - 1. Primary air barrier:
 - a. Substrate temperature must be above 20 degrees F (-6 degrees C) and rising.
- B. Auxiliary products:
 - 1. Temperature limitations may vary. Refer to air barrier manufacturer published literature.

C. Application of flashing:

1. Self-adhered flashing:

- a. Where required install adhesive/primer recommended by air barrier manufacturer continuously at rate recommended ensuring complete substrate coverage of anticipated flashing installation area.
 - 1) Allow adhesive/primer to cure to a tacky film prior to application of flashing.
 - 2) Only apply adhesive/primer to surfaces which will be covered during the same working day. Primed areas not covered by end of day must be re-primed prior to installation of flashing.
- b. Measure and cut self-adhered flashing to ensure adequate length to achieve continuous coverage of desired installation.
- c. Peel protective film from leading edge of self-adhered flashing and align top of membrane verifying proper positioning prior to complete film removal and flashing placement.
- d. Press self-adhered flashing firmly into place by applying hand pressure to the middle of the membrane and working the pressure to the edges eliminating wrinkles and air bubbles.
- e. Install self-adhered flashings in shingle fashion to eliminate reverse laps.
- f. Where required, prime laps at rate recommended by air barrier manufacture to ensure complete coverage of anticipated lap installation.
- g. Lap adjoining edges a minimum of two (2) inches.
- h. Roll flashing and laps with countertop roller to obtain thorough adhesion.
- i. Seal end of day exposed leading edges of self-adhered flashing with building envelope sealant.

2. Liquid-applied flashing:

- a. Apply a uniform film of aerosol spray adhesive to raw edges of gypsum sheathing at rate recommended by air barrier manufacturer to completely encapsulate cut edge of gypsum sheathing.
- b. Allow adhesive to cure to a tacky film prior to application of liquid-applied flashing.
- c. Apply flashing in accordance with and at rate recommended by air barrier manufacturer.
- d. Spread flashing to achieve a monolithic membrane over substrate requiring flashing.
- e. Allow flashing to cure prior to subsequent installations.

D. Detailing/Flashing:

1. Complete detailing and flashing installations per air barrier manufacturer's published literature.
2. Refer to air barrier manufacturer guide details for further clarification and installation procedures including, but not limited to, the following:

- a. Inside corners, outside corners, pipe penetrations, shelf angles, wall to foundation transitions
- b. Rough openings:
 - 1) Install rough opening details per window manufacturer's published literature and in accordance with ASTM E2112.
 - 2) Wall assemblies containing a vapor retarder on the interior wall assembly:
 - a) Extend flashing into rough opening to ensure sufficient membrane for connection with vapor retarder and provide a continuous air barrier assembly.
- 3. Reverse laps:
 - a. Seal permanently exposed leading edges with sealant:
 - 1) Building envelope sealant
 - 2) Termination sealant
 - 3) Liquid flashing
- 4. Moving Joints and Transitions:
 - a. Per air barrier manufacturer's published literature.
- E. Thru-Wall Flashing:
 - 1. Coordinate with other flashing sections.
- F. Application of Primary Fluid-Applied, Air and Vapor Barrier:
 - 1. Apply air barrier in continuous, monolithic application without sags, runs, or voids, transitioning onto flashing membrane and overlapping one (1) inch, to create uniform drainage plane and air barrier.
 - 2. Install air barrier so that subsequent membrane installation laps one (1) inch onto flashing ensuring an air and air barrier assembly.
 - 3. Allow air barrier to fully cure prior to placement of insulation.
 - 4. Total dry film thickness (DFT):
 - a. Coverage rates may vary due to surface texture or porosity. Refer to air barrier manufacturer Technical Data Sheet for recommended coverage rates.
- G. Insulation Adhesive:
 - 1. Coordinate with related sections for insulating materials.
 - 2. Upon curing of the air barrier apply insulation adhesive in a serpentine pattern.
 - 3. Immediately embed insulation into the adhesive and press firmly into place to ensure full contact. Apply additional adhesive if allowed to skin over.
 - 4. Fully butter all joints of insulation panels with adhesive during installation, with the exception of expansion joints.
- H. Fastener Penetrations Through Primary Air Barrier:

1. Install fasteners and components in accordance with the air barrier manufacturer's published literature.
2. Supplemental sealant:
 - a. Penetrations that do not meet installation requirements require the addition of sealant at point of insertion through the air barrier membrane to maintain continuity in the air barrier assembly.

3.5 CLEANING AND PROTECTION

- A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
- B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.
- C. Remove masking materials after installation.

END OF SECTION 072726

SECTION 074213.13 - 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. Concealed-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 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. 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, including corner, soffits, supports, attachments, and accessories. Mockup shall incorporate all exterior components from vertical framing to metal panel.
 2. Size: Minimum 48 inches wide.
 3. Water-Spray Test: Conduct water-spray test of metal panel assembly mockup, testing for water penetration according to AAMA 501.2.
 4. 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 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 Substantial Completion.

- 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 Delta E units when tested according to ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

- 2. Finish Warranty Period: 20 years from date of Substantial Completion.

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 E1592:

- 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 E283 at the following test-pressure difference:
 1. Test-Pressure Difference: 6.24 lbf/sq. ft.
 - C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:
 1. Test-Pressure Difference: 6.24 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 CONCEALED-FASTENER, LAP-SEAM METAL WALL PANELS
- A. Provide factory-formed metal panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant inside laps. Include accessories required for weathertight installation.
 - B. Asymmetrical Rib, Concealed-Fastener Metal Wall Panels (MS1): Formed with vertical panel edges and ribs asymmetrically spaced (one per panel) with a flat pan between panel edges, and with lap joint between panels. See Drawings for location.
 1. Basis of Design Profile: Metal Sales Manufacturing Corporation; Contempra Series™, profile CN88-1212 CF Wall.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ATAS International, Inc.
 - b. Berridge Manufacturing Company.
 - c. CENTRIA Architectural Systems.
 - d. MBCI.
 - e. Metal Sales & Service, Inc.
 - f. Metal Sales Manufacturing Corporation.
 - g. PAC-CLAD; Petersen Aluminum Corporation; a Carlisle company.
 3. Aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
 - a. Nominal Thickness: 0.028 inch minimum.
 - b. Exterior Finish: Three-coat fluoropolymer.
 - c. Color: As selected by Architect from manufacturer's full range.

4. Panel Coverage: 12 inches.
 5. Panel Height: 0.875 inch.
- C. Asymmetrical Rib, Concealed-Fastener Metal Wall Panels (MS2): Formed with vertical panel edges and ribs asymmetrically spaced (three per panel), and with lap joint between panels. See Drawings for location.
1. Basis of Design Profile: Metal Sales Manufacturing Corporation; Contempra Series™, profile CN88-1653 CF Wall.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ATAS International, Inc.
 - b. Berridge Manufacturing Company.
 - c. CENTRIA Architectural Systems.
 - d. MBCI.
 - e. Metal Sales & Service, Inc.
 - f. Metal Sales Manufacturing Corporation.
 - g. PAC-CLAD; Petersen Aluminum Corporation; a Carlisle company.
 3. Aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
 - a. Nominal Thickness: 0.028 inch minimum.
 - b. Exterior Finish: Three-coat fluoropolymer.
 - c. Color: As selected by Architect from manufacturer's full range.
 4. Panel Coverage: 16 inches.
 5. Panel Height: 0.875 inch

2.3 MISCELLANEOUS MATERIALS

- A. 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.
- B. 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, end walls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

- C. 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.
- D. 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 C920; 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 C1311.

2.4 FABRICATION

- A. 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. 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.
- 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 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. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.
 - 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 C754 and metal panel manufacturer's written recommendations.

3.3 INSTALLATION

- A. 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. 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.
 4. Flash and seal panels with weather closures at perimeter of all openings.
- 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, 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.
- 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 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 074213.13

SECTION 076200 - SHEET METAL FLASHING AND TRIM

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. Manufactured through-wall flashing.
2. Manufactured reglets with counterflashing.
3. Formed roof-drainage sheet metal fabrications.
4. Formed wall sheet metal fabrications.

B. Related Requirements:

1. Section 061053 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 134119 "Metal Building Systems" for flashing components provided by metal building manufacturer.

1.3 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.

1.4 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 manufactured product and accessory.

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 roof-penetration flashing.
8. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
9. Include details of special conditions.
10. Include details of connections to adjoining work.

C. 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.
4. Anodized Aluminum Samples: Samples to show full range to be expected for each color required.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- C. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

1.7 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.

1.8 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. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
- 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.

1.9 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 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 Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies shall 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 shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" 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 according to SPRI ES-1 and capable of resisting the design pressures noted on Drawings.
- D. Seismic Performance: Sheet metal flashing and trim shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. Seismic Design Category: As noted on Drawings.
- 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 Insert temperature change.

2.2 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

- B. Aluminum Sheet: ASTM B 209 alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.
 - 1. Exposed Coil-Coated Finish:
 - a. Two-Coat Fluoropolymer: AAMA 620. 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. Color: As selected by Architect from manufacturer's full range.
 - 3. 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
- C. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 or H01 temper.
 - 1. Non-patinated Exposed Finish: Mill.
- D. Stainless-Steel Sheet: ASTM A 240/A 240M, dead soft, fully annealed; with smooth, flat surface.
 - 1. Finish: 2D (dull, cold rolled).

2.3 UNDERLAYMENT MATERIALS

- A. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.
- B. Synthetic Underlayment: Laminated or reinforced, woven polyethylene or polypropylene, synthetic roofing underlayment; bitumen free; slip resistant; suitable for high temperatures over 220 deg F and complying with physical requirements of ASTM D 226/D 226M for Type I and Type II felts.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Atlas Roofing Corporation; Summit.
 - b. Engineered Coated Products; Nova-Seal II.
 - c. Kirsch Building Products, LLC; Sharkskin Comp.
 - d. SDP Advanced Polymer Products Inc; Palisade.
- C. Self-Adhering, High-Temperature Sheet: 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 according to written recommendations of underlayment manufacturer.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Carlisle Residential, a division of Carlisle Construction Materials; WIP 300HT.
 - b. Grace Construction Products, a unit of W. R. Grace & Co.-Conn.; Grace Ice and Water Shield HT.
 - c. Henry Company; Blueskin PE200 HT.
 - d. Kirsch Building Products, LLC; Sharkskin Ultra SA.
 - e. Metal-Fab Manufacturing, LLC; MetShield.
 - f. Owens Corning; WeatherLock Specialty Tile & Metal Underlayment.
 - g. Polyguard Products, Inc.; Deck Guard HT.
 - h. Protecto Wrap Company; Protecto Jiffy Seal Ice & Water Guard HT.
 - i. SDP Advanced Polymer Products Inc; Palisade SA-HT.
- 2. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F or higher.
 - 3. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F or lower.

D. Slip Sheet: Rosin-sized building paper, 3 lb./100 sq. ft. minimum.

2.4 MISCELLANEOUS MATERIALS

- A. General: 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. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
 - 2. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
- C. Solder:
 - 1. For Copper: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead with maximum lead content of 0.2 percent.
- D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inchwide and 1/8 inch thick.
- E. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

- H. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.
- I. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.5 MANUFACTURED SHEET METAL FLASHING AND TRIM

- A. Through-Wall, Ribbed, Sheet Metal Flashing: Manufacture through-wall sheet metal flashing for embedment in masonry, with ribs at 3-inch intervals along length of flashing to provide integral mortar bond.
 - 1. Copper: 10-oz. minimum for fully concealed flashing; 16 oz. elsewhere.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Cheney Flashing Company; Cheney Flashing Dovetail.
 - 2) Hohmann & Barnard, Inc.; STF Sawtooth Flashing.
 - 3) Keystone Flashing Company, Inc.; Keystone Three-Way Interlocking Thruwall Flashing.
 - 4) Sandell Manufacturing; Pre-Formed Metal Flashing.
 - 2. Stainless Steel: 0.016 inch thick.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Cheney Flashing Company; Cheney Flashing Dovetail.
 - 2) Hohmann & Barnard, Inc.; STF Sawtooth Flashing.
 - 3) Keystone Flashing Company, Inc.; Keystone Three-Way Interlocking Thruwall Flashing.
 - 4) Sandell Manufacturing; Pre-Formed Metal Flashing.
- B. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cheney Flashing Company.
 - b. Fry Reglet Corporation.
 - c. Heckmann Building Products, Inc.
 - d. Hickman, W. P. Company.
 - e. Hohmann & Barnard, Inc.
 - f. Keystone Flashing Company, Inc.
 - g. National Sheet Metal Systems, Inc.
 - h. Sandell Manufacturing.
 - 2. Material: Stainless steel, 0.019 inch thick.
 - 3. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.

4. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
5. Finish: With manufacturer's standard color coating.

2.6 ROOF-EDGE DRAINAGE SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Architectural Products Company.
 2. ATAS International, Inc.
 3. Berger Building Products, Inc.
 4. Castle Metal Products.
 5. Cheney Flashing Company.
 6. CopperCraft by FABRAL.
 7. Drexel Metals.
 8. Hickman Company, W. P.
 9. Merchant & Evans Inc.
 10. Metal-Era, Inc.
 11. Perimeter Systems; a division of SAF.
- B. Gutters: Manufactured in uniform section lengths not exceeding 12 feet, with matching corner units, ends, outlet tubes, and other accessories. Elevate back edge at least 1 inch above front edge. Furnish flat-stock gutter straps, gutter brackets, expansion joints, and expansion-joint covers fabricated from same metal as gutters.
1. Aluminum Sheet: 0.040 inch thick.
 2. Gutter Profile: Style A according to SMACNA's "Architectural Sheet Metal Manual."
 3. Corners: Factory mitered and mechanically clinched and sealed watertight.
 4. Gutter Supports: Manufacturer's standard supports as selected by Architect with finish matching the gutters.
 5. Gutter Accessories: Continuous snap-in plastic leaf guard.
- C. Downspouts: Plain rectangular complete with mitered elbows, manufactured from the following exposed metal. Furnish with metal hangers, from same material as downspouts, and anchors.
1. Formed Aluminum: 0.040 inch thick.
- D. Aluminum Finish: Two-coat fluoropolymer.

2.7 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
1. 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.
 2. Obtain field measurements for accurate fit before shop fabrication.

3. 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.
 4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Fabrication Tolerances: 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.
- 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 to provide for proper installation of elastomeric sealant according to cited sheet metal standard.
- E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- F. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.
- G. 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.

2.8 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Roof Edge Flashing: Fabricate in minimum 96-inch- long, but not exceeding 12-foot- long sections. Furnish with 6-inch- wide, joint cover plates.
1. Joint Style: Overlapped, 4 inches wide.
 2. Fabricate from the Following Materials:
 - a. Stainless Steel: 0.019 inch thick.
- B. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
1. Copper: 16 oz./sq. ft.
 2. Stainless Steel: 0.019 inch thick.
- C. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
1. Copper: 16 oz./sq. ft.
 2. Stainless Steel: 0.019 inch thick.

D. Flashing Receivers: Fabricate from the following materials:

1. Stainless Steel: 0.019 inch thick.

2.9 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- long, but not exceeding 12-foot- long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings; and form with 2-inch- high, end dams. Fabricate from the following materials:

1. Copper: 16 oz./sq. ft.
2. Stainless Steel: 0.016 inch thick.

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 UNDERLAYMENT INSTALLATION

- A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.
- B. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, according to manufacturers' written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.
- C. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, 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 and edges with roller. Cover underlayment within 14 days.

3.3 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 - 1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 - 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 - 3. Space cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
 - 4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
 - 5. Torch cutting of sheet metal flashing and trim is not permitted.
 - 6. 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. Coat concealed side of uncoated-aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
 - 2. 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. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
 - 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
 - 2. Use lapped expansion joints only where indicated on Drawings.
- D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- 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. Embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for

installation at higher ambient temperatures. 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 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
- B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.
- C. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.
- D. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints minimum of 4 inches. Secure in waterproof manner by means of interlocking folded seam or blind rivets and sealant unless otherwise indicated.
- E. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.5 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Through-Wall Flashing: Installation of through-wall flashing is specified in Section 042000 "Unit Masonry."
- C. Reglets: Installation of reglets is specified in Section 042000 "Unit Masonry."

3.6 MISCELLANEOUS FLASHING INSTALLATION

- A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.
- B. Overhead-Piping Safety Pans: Suspend pans from structure above, independent of other overhead items such as equipment, piping, and conduit, unless otherwise indicated on Drawings. Pipe and install drain line to plumbing waste or drainage system.

3.7 ERECTION 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.

3.8 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering. Clean off excess sealants.
- B. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.
- C. 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.

END OF SECTION 076200

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. Urethane joint sealants.
 - 3. Latex joint sealants.
 - 4. Acoustical joint sealants

1.3 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. 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.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Product Test Reports: For each kind of joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.5 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.

1.6 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
 - 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.

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. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's standard range.

2.2 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, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Dow Corning Corporation.
 - b. GE Construction Sealants; Momentive Performance Materials Inc.
 - c. Polymeric Systems, Inc.
 - d. Schnee-Morehead, Inc., an ITW company.
 - e. Sherwin-Williams Company (The).

2.3 LATEX JOINT SEALANTS

- A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. BASF Corporation; Construction Systems.
 - b. Franklin International.
 - c. May National Associates, Inc.; a subsidiary of Sika Corporation.
 - d. Pecora Corporation.
 - e. Sherwin-Williams Company (The).
 - f. Tremco Incorporated.

2.4 URETHANE JOINT SEALANTS

- A. Urethane, S, NS, 25, NT: Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. BASF Corporation; Construction Systems.
 - b. Bostik, Inc.
 - c. ER Systems; an ITW Company.
 - d. Pecora Corporation.
 - e. Polymeric Systems, Inc.
 - f. Schnee-Morehead, Inc., an ITW company.
 - g. Sherwin-Williams Company (The).
 - h. Sika Corporation; Joint Sealants.
 - i. Tremco Incorporated.

2.5 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Sealant for Concealed Joints: Manufacturer's standard nonsag, nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber acoustical sealant.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Pecora Corporation.
 - b. Serious Energy Inc.
 - c. United States Gypsum Company

2.6 MISCELLANEOUS MATERIALS

- A. 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.
- B. 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. Unglazed surfaces of ceramic tile.
 - 3. 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 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. 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.
- D. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C919, ASTM C1193, and manufacturer's written recommendations for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.
- E. Acoustical Ceiling Areas: Apply acoustical joint sealant at perimeter edge moldings of acoustical ceiling areas in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

3.4 CLEANING

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

3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of 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.

3.6 JOINT-SEALANT SCHEDULE

- A. 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.
 - c. Other joints as indicated on Drawings.
 2. Joint Sealant: Acrylic latex.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's standard range of colors.
- B. 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. 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 standard range of colors.
- C. Joint-Sealant Application: Single-component urethane exterior joints in vertical surfaces and horizontal nontraffic surfaces.
- 1. Joint Locations:
 - a. Joints in roofing system components.
 - 2. Joint Sealant: Urethane, Type S, Grade NS, Class 25, Use NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's standard range of colors.
- D. Joint-Sealant Application: Acoustical interior joints in vertical and horizontal nontraffic surfaces.
- 1. Joint Locations:
 - a. Perimeter joints between interior wall surfaces, ceilings, frames of interior doors and borrowed lights.
 - b. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's standard range of colors.

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL DOORS AND 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 work.
- B. Related Requirements:
 - 1. Section 087100 Door Hardware for door hardware for hollow-metal doors.

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, core descriptions, fire-resistance ratings, and finishes.
- B. 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 anchorages, joints, field splices, and connections.
 - 7. Details of accessories.
 - 8. Details of moldings, removable stops, and glazing.
 - 9. Details of conduit and preparations for power, signal, and control systems.
- C. Samples for Verification:

1. For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches.
 2. For "Doors" and "Frames" subparagraphs below, prepare Samples approximately 12 by 12 inches to demonstrate compliance with requirements for quality of materials and construction:
 - a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
 - b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing if applicable.
- D. 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 hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

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 stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Ceco Door; ASSA ABLOY.
 2. Curries Company; ASSA ABLOY.
 3. Steelcraft; an Allegion brand.
- B. 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 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 DOORS AND FRAMES

- A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2.
 - 1. Physical Performance: Level B according to SDI A250.4.
 - 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches.
 - c. Face: Metallic-coated, cold-rolled steel sheet, 18 gauge.
 - d. Edge Construction: Model 1, Full Flush.
 - e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
 - 3. Frames:
 - a. Materials: Metallic-coated steel sheet, 16 gauge, with minimum A60 coating for masonry walls, uncoated for steel stud walls.
 - b. Sidelite Frames: Fabricated from same thickness material as adjacent door frame.
 - c. Construction: Full profile welded.
 - 4. Exposed Finish: Prime.

2.4 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

- A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2.

1. Physical Performance: Level B according to SDI A250.4.
2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches
 - c. Face: Metallic-coated steel sheet, 16 gauge, with minimum A60 coating.
 - d. Edge Construction: Model 1, Full Flush.
 - e. Core: Manufacturer's standard polystyrene, polyurethane, or polyisocyanurate core at manufacturer's discretion.
3. Frames:
 - a. Materials: Metallic-coated steel sheet, 14 gauge, with minimum A60 coating.
 - b. Construction: Full profile welded.
4. Exposed Finish: Prime.

2.5 BORROWED LITES

- A. Hollow-metal frames of metallic-coated steel sheet, minimum thickness of 0.042 inch.
- B. Construction: Full profile welded.

2.6 FRAME ANCHORS

- A. Jamb Anchors:
 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042-inch-thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
 3. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
- B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:
 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
 2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

2.7 FRAME REINFORCEMENTS

- A. Mortise hinge reinforcements shall be 7-gauge.
- B. Provide high frequency full mortise hinge reinforcement for top hinge in accordance with SDI 111-H. Provide at all frames 3'4" wide and greater, and at heavy-use areas: multi-purpose, kitchen, and gymnasium.

- C. Surface mounted closers, overhead stops and holders reinforcements shall be 14 gauge steel plate welded inside jamb.
- D. Reinforce for rim mounted strikes with 16-gauge steel sheet welded on inside of jamb.
- E. Drill and tap for surface mounted hardware at job site.
- F. Strikes for mortise locks and cylindrical locks shall be 4-7/8" and conform to ANSI A115.1 and A115.2

2.8 DOOR HARDWARE REINFORCEMENTS

- A. Reinforce for rim exit devices with 16-gauge steel channels projection welded or bonded to the door edge at lock and hinge side of door. Reinforce at top and bottom of doors for surface mounted vertical latches.
- B. Reinforcement for Mortise locks shall be 16-gauge steel projection welded to edge of door with stabilizing tabs to keep lock body centered in mortise.
- C. Reinforcement for cylindrical latch/locksets with 16-gauge steel projection welded to edge of door. The reinforcement to include tabs to center the latch bolt horizontally and vertically.
- D. Reinforcement for flushbolts shall be 16-gauge steel angle projection welded to edge of door or 14-gauge steel astragal with tabs drilled and tapped to receive flushbolt.
- E. Reinforcement for surface mounted door closers and overhead stops and holders shall be 14-gauge steel.
- F. Provide high frequency hinge reinforcements at top & bottom hinge of all exterior doors and in high traffic applications such as stair wells, cafeterias and loading dock areas.

2.9 OTHER PREPARATION REQUIREMENTS

- A. Mortised Hardware preps including function holes shall be prepared by manufacturer or supplier prior to delivery to job site using hardware manufacturer's templates. Trim holes and mounting holes shall be field drilled and tapped.
- B. Surface mounted hardware shall be drilled and tapped in the field.
- C. All Doors shall have 1/8" in 2" bevel at both hinge and strike edge of door.
- D. Reinforce top and bottom of door with 14-gauge inverted channel welded to both face sheets. Channels shall be galvanized at exterior and cold rolled steel at interior doors.
- E. Fabricate glass trim from 24 gage steel confirming to galvanized steel (A60) at exterior openings, and cold rolled steel at interior openings. Furnish with reinforced and welded corners. Kits shall be flush with face of door and have no exposed fasteners.
- F. Finish tops of exterior doors with flush top cap welded or applied with screws to secure top cap into top channel of door. All seams and exposed fasteners shall be completely sealed & watertight.

2.10 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. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- D. 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.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- F. 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.
- G. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.
- H. Mineral-Fiber Insulation: ASTM C 665, 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 E 136 for combustion characteristics.
- I. Glazing: Comply with requirements in Section 088000 "Glazing."
- J. Bituminous 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.

2.11 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 Doors:
 - 1. Fire Door Cores: As required to provide fire-protection ratings indicated.
 - 2. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches.
 - 3. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets.

4. Bottom Edge Closures: Close bottom edges of doors with end closures or channels of same material as face sheets.
 5. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
 6. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
- C. 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. Sidelite 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. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
 4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
 5. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 16 inches from top and bottom of frame. Space anchors not more than 32 inches o.c., to match coursing, and as follows:
 - 1) Two anchors per jamb up to 60 inches high.
 - 2) Three anchors per jamb from 60 to 90 inches high.
 - b. 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.
 - c. Compression Type: Not less than two anchors in each frame.
 - d. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
 6. 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.
- D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.

- E. 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 doors and frames to receive non-templated, mortised, and surface-mounted door hardware.
 - 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
- F. 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. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 - 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 - 4. Provide loose stops and moldings on inside of hollow-metal work.
 - 5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.12 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.

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. 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 doors and frames to receive non-templated, mortised, and surface-mounted door 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 for doors, transoms, sidelites, borrowed lites, and other openings, 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. Install frames with removable stops located on secure side of opening.
 - c. Install door silencers in frames before grouting.
 - d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - e. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - f. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 - 3. Metal-Stud Partitions: 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.
 - 5. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
 - 6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 - 7. In-Place Metal or Wood-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.
 - 8. 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. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
 - 1. Non-Fire-Rated Steel Doors:
 - a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
 - c. At Bottom of Door: 3/4 inch plus or minus 1/32 inch.
 - d. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.
 - 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
- D. 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: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. 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. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- E. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.
- F. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

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 machining for hardware.

B. Related Requirements

1. Section 012300 "Alternates" for procedures for alternates for Owner Preferred Brands.

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 Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish.
2. Plastic laminate, 6 inches square, for each color, texture, and pattern selected.
3. Corner sections of doors, approximately 8 by 10 inches, with door faces and edges representing actual materials to be used.
 - a. Provide Samples for each species of veneer and solid lumber required.

1.4 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.

1.5 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.

1.6 WARRANTY

- A. 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 Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Wood 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 UL 10C or NFPA 252.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Algoma Hardwoods, Inc.
 - 2. Ampco Products, LLC.
 - 3. Eggers Industries.
 - 4. Mohawk Flush Doors, Inc.
 - 5. Oshkosh Door Company.
 - 6. VT Industries Inc.
- B. Source Limitations: Obtain flush wood doors from single manufacturer.
- C. Alternative Manufacturers – Owner Preferred Brands (Refer to Section 012300 – Alternates)
 - 1. Marshfield (no substitution)

2.3 FLUSH WOOD DOORS, GENERAL

- A. WDMA I.S.1-A Performance Grade: Heavy Duty.
- B. Particleboard-Core Doors:
 - 1. Particleboard: ANSI A208.1, Grade LD-2.

2.4 VENEER-FACED DOORS FOR TRANSPARENT FINISH

- A. Interior Solid-Core Doors:
 - 1. Grade: Premium, with Grade A faces.
 - 2. Species: Red oak.
 - 3. Cut: Rotary cut.
 - 4. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering.
 - 5. Core for Fire-Rated Doors: As required to achieve fire-protection rating indicated on Drawings.
 - a. Blocking for Mineral-Core Doors: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated on Drawings.

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.
- 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.

2.6 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: WDMA TR-4 conversion varnish or WDMA TR-6 catalyzed polyurethane.
 - 3. Staining: As selected by Architect from manufacturer's full range.

4. Effect: Open-grain finish.
5. Sheen: Satin.

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.
- C. Install fire-rated doors and frames in accordance with NFPA 80.
- D. Job-Fitted Doors:
 1. Align and fit doors in frames with uniform clearances and bevels as indicated below.
 - a. Do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors.
 2. Machine doors for hardware.
 3. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
 4. Clearances:
 - a. Provide 1/8 inch at heads, jambs, and between pairs of doors.
 - b. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
 5. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
 6. Bevel fire-rated doors 1/8 inch in 2 inches at lock edge; trim stiles and rails only to extent permitted by labeling agency.
- E. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- F. 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 083473.16 - WOOD SOUND CONTROL DOOR ASSEMBLIES

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 wood sound control door assemblies.

1.3 COORDINATION

- A. Coordinate installation of anchorages for sound control door assemblies. Furnish setting drawings, templates, and directions for installing anchorages. Deliver sleeves, inserts, anchor bolts, and items with integral anchors to Project site in time for installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include sound ratings, construction details, material descriptions, core descriptions, fire-resistance rating, and finishes.
- B. Shop Drawings: For sound control door assemblies.
 - 1. Include elevations of each door design.
 - 2. Include details of sound control seals, door bottoms, and thresholds.
 - 3. Include details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 - 4. Include frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 5. Include locations of reinforcements and preparations for hardware.
 - 6. Include details of each different wall opening condition.
 - 7. Include details of anchorages, joints, field splices, and connections.
 - 8. Include details of accessories.
 - 9. Include details of moldings, removable stops, and glazing.
- C. Samples for Verification: For each type of exposed finish not less than 3 by 5 inches.
 - 1. Doors and Frames: Samples approximately 12 by 12 inches.
 - a. Doors: Include section of vertical-edge, top, and bottom construction; automatic door bottom or gasket; core construction; glazing; and hinge and other applied hardware reinforcement.
 - b. Frames: Include profile, corner joint, floor and wall anchors, and seals.
- D. Schedule: Provide a schedule of sound control door assemblies prepared using same reference numbers for details and openings as those on Drawings. Coordinate with the Door Hardware Schedule.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of sound control door assembly.
- C. Product Test Reports: For each sound control door assembly, for tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Sample Warranty: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sound control door assemblies 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.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Avoid the use of 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 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.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install wood sound control doors until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of sound control door assemblies that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure to meet sound rating requirements.
 - b. Faulty operation of sound seals.
 - c. Deterioration of metal frames, metal finishes, and other materials beyond normal use or weathering.

- d. Wood doors that are warped (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section or show telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Sound Rating: Provide sound control door assemblies identical to those of assemblies tested as sound-retardant units by an acoustical testing agency, and have the following minimum rating:
 1. STC Rating: 56 as calculated by ASTM E413 when tested in an operable condition according to ASTM E90.
- B. 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.

2.2 WOOD SOUND CONTROL DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ambico Limited.
 2. Eggers Industries.
 3. Krieger Specialty Products Company.
 4. Marshfield Door Systems, Inc.
 5. Overly Door Company.
 6. Security Acoustics.
 7. Vancouver Door Company.
- B. Source Limitations: Obtain wood sound control door assemblies, including doors, frames, sound control seals, hinges, thresholds, and other items essential for sound control, from single source from single manufacturer.
- C. Doors: Flush-design sound control doors, 1-3/4 inches thick; with manufacturer's standard sound-retardant core as required to provide STC and fire rating indicated. Fabricate according to WDMA 1.S.1-A.
- D. Materials: Comply with Section 081416 "Flush Wood Doors" for grade, faces, veneer matching, fabrication, finishing, and other requirements unless otherwise indicated.
- E. Finishes:
 1. Factory finish sound control wood doors to match doors specified in Section 081416 "Flush Wood Doors."

2.3 SOUND CONTROL FRAMES

- A. Frames: Fabricate sound control door frames with corners mitered, reinforced, and continuously welded the full depth and width of frame. Fabricate according to NAAMM-HMMA 865.
1. Weld frames according to NAAMM-HMMA 820.
 2. Interior Frames: Fabricate from cold-rolled steel sheet unless otherwise indicated, 0.075-inch nominal thickness or thicker as required to provide STC rating indicated.
 3. Hardware Reinforcement: Fabricate according to NAAMM-HMMA 865 of same material as face sheets.
 4. Jamb Anchors:
 - a. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.048-inch nominal-thickness uncoated steel unless otherwise indicated.
 5. Floor Anchors: Not less than 0.079-inch nominal-thickness metallic-coated steel, and as follows:
 - a. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
 6. Ceiling Struts: Minimum 3/8-inch-thick by 2-inch-wide uncoated steel unless otherwise indicated.
 7. Plaster Guards: Metallic-coated steel sheet, not less than 0.026 inch thick.
- B. Materials:
1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
 2. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
 3. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B, with G60 zinc (galvanized) or A40 zinc-iron-alloy (galvannealed) coating designation.
 4. Supports and Anchors: After fabricating, galvanize units to be built into exterior walls according to ASTM A153/A153M, Class B.
 5. Inserts, Bolts, and Fasteners: Provide items to be built into exterior walls, hot-dip galvanized according to ASTM A153/A153M or ASTM F2329.
 6. Powder-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 sound control door frames of type indicated.
 7. Mineral-Fiber Insulation: Insulation composed of rock-wool fibers, slag-wool fibers, or glass fibers.
- C. Finishes:
1. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
 - a. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.4 HARDWARE

- A. Sound Control Door Hardware: Manufacturer's standard sound control system, including head and jamb seals, door bottoms, and thresholds, as required by testing to achieve STC and fire rating indicated.
 - 1. Head and Jamb Seals:
 - a. Neoprene Compression Seals: One-piece units consisting of closed-cell sponge neoprene seal held in place by metal retainer, with retainer cover of same material as door frame; attached to door frame with concealed screws.
 - 2. Automatic Door Bottoms: Neoprene or silicone gasket, held in place by metal housing, that automatically drops to form seal when door is closed; mounted to bottom edge of door with screws.
 - a. Mounting: Mortised or semi-mortised into bottom of door as required by testing to achieve STC rating indicated.
 - 3. Thresholds: Flat, smooth, unfluted type as recommended by manufacturer; fabricated from aluminum.
 - a. Finish: Clear anodic finish.
- B. Other Hardware: Comply with requirements in Section 087100 "Door Hardware."

2.5 SOUND CONTROL ACCESSORIES

- A. Grout: Comply with ASTM C476, with a slump of not more than 4 inches as measured according to ASTM C143/C143M.

2.6 FABRICATION

- A. Wood Sound Control Door Fabrication: Factory fit doors to suit frame-opening sizes indicated, with uniform clearances and bevels according to WDMA I.S.1-A unless otherwise indicated. Comply with final door hardware schedules and hardware templates.
 - 1. Comply with requirements in NFPA 80 for fire-rated and smoke control doors.
 - 2. Locate door hardware as indicated, or if not indicated, according to DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
 - a. Coordinate measurements of hardware mortises in steel frames to verify dimensions and alignment before factory machining.
- B. Sound Control Frame Fabrication: Fabricate sound control frames to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. 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.
 - 1. Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible. Where frames are fabricated in sections due to shipping or handling limitations,

- provide alignment plates or angles at each joint, fabricated from same thickness metal as frames.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 3. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 4. 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 in height.
 - 2) Four anchors per jamb from 60 to 90 inches in height.
 - 3) Five anchors per jamb from 90 to 96 inches in height.
 - 4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches, or fraction thereof, more than 96 inches in height.
 - 5) Two anchors per head for frames more than 42 inches wide and mounted in metal-stud partitions.
 - b. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
 5. Hardware Preparation: Factory prepare sound control frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping.
 - a. Reinforce frames to receive nontemplated mortised and surface-mounted door hardware.
 6. Plaster Guards: Weld guards to frame at back of hardware cutouts and glazing-stop screw and sound control seal preparations to close off interior of openings in frames to be grouted.
 7. Tolerances: Fabricate frames to tolerances indicated in NAAMM-HMMA 865.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, 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. 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. Prior to installation, adjust and securely brace sound control door frames to the following tolerances:

1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.
- C. Drill and tap doors and frames to receive nontemplated mortised and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install sound control door assemblies plumb, rigid, properly aligned, and securely fastened in place; comply with manufacturer's written instructions.
- B. Frames: Install sound control door frames in sizes and profiles indicated.
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. Check squareness, twist, and plumbness of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 3. Metal-Stud Partitions: Fully fill frames with mineral-fiber insulation.
 4. Ceiling Struts: Extend struts vertically from top of frame at each jamb to supporting construction above unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction above. Provide adjustable wedged or bolted anchorage to frame jamb members.
 5. Grouted Frames: Solidly fill space between frames and substrate with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
 6. Installation Tolerances: Adjust sound control door frames for squareness, alignment, twist, and plumbness 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 on a perpendicular line from head to floor.
- C. Doors: Fit sound control doors accurately in frames, within clearances indicated below. Shim as necessary.
 - 1. Non-Fire-Rated Doors: Fit non-fire-rated doors accurately in frames with the following clearances:
 - a. Jambs: 1/8 inch.
 - b. Head with Butt Hinges: 1/8 inch.
 - c. Head with Cam-Lift Hinges: As required by manufacturer, but not more than 3/8 inch.
 - d. Sill: Manufacturer's standard.
 - e. Between Edges of Pairs of Doors: 1/8 inch.
 - 2. Fire-Rated Doors: Install fire-rated doors with clearances according to NFPA 80.
- D. Sound Control Seals: Where seals have been factory prefitted and preinstalled and subsequently removed for shipping, reinstall seals and adjust according to manufacturer's written instructions.
- E. Thresholds: Set thresholds in full bed of sealant complying with requirements in Section 079200 "Joint Sealants."

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and adjust seals, door bottoms, and other sound control hardware items right before final inspection. Leave work in complete and proper operating condition.
- B. Remove and replace defective work, including defective or damaged sound seals and doors and frames that are warped, bowed, or otherwise unacceptable.
 - 1. Adjust gaskets, gasket retainers, and retainer covers to provide contact required to achieve STC rating.
- C. Grouted Frames: Clean grout off sound control door frames immediately after installation.
- D. Prime-Coat Touchup: Immediately after erection of frames, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible, rust-inhibitive, air-drying primer.

END OF SECTION 083473.16

SECTION 083613 - SECTIONAL 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 electrically operated insulated sectional doors.
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications" for miscellaneous steel supports.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type and size of sectional door and accessory.
 - 1. Include construction details, material descriptions, dimensions of individual components, profile door sections, and finishes.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
- 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. 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. Include diagrams for power, signal, and control wiring.
- C. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sectional doors 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 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 sectional doors 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. Failure of components or operators before reaching required number of operation cycles.
 - c. Faulty operation of hardware.
 - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use; rust through.
 - e. Delamination of exterior or interior facing materials.

- 2. Warranty Period: Five years from date of Substantial Completion.

- B. Special Finish Warranty: Manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.

- 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS, GENERAL

- A. Source Limitations: Obtain sectional doors from single source from single manufacturer.
 - 1. Obtain operators and controls from sectional door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Sectional doors shall comply with performance requirements specified without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.
 - 1. Design Wind Load: As indicated on Drawings.
 - 2. Testing: According to ASTM E 330.
 - 3. Deflection Limits: Design sectional doors to withstand design wind loads without evidencing permanent deformation or disengagement of door components.
 - a. Deflection of door sections in horizontal position (open) shall not exceed 1/120 of the door width.

- b. Deflection of horizontal track assembly shall not exceed 1/240 of the door height.
- 4. Operability under Wind Load: Design overhead coiling doors to remain operable under uniform pressure (velocity pressure) of 20 lbf/sq. ft. wind load, acting inward and outward.
- C. Seismic Performance: Sectional doors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. Component Importance Factor: As indicated on Drawings.

2.3 DOOR ASSEMBLY

- A. Steel Sectional Door: Sectional door formed with hinged sections and fabricated according to DASMA 102 unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. C.H.I. Overhead Doors, Inc.
 - b. Clopay Building Products.
 - c. Overhead Door Corporation.
 - d. Wayne-Dalton Corp.
- B. Operation Cycles: Door components and operators capable of operating for not less than 50,000. 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.
- C. Air Infiltration: Maximum rate of 0.4 cfm/sq. ft. at 15 and 25 mph when tested according to ASTM E 283 or DASMA 105.
- D. R-Value: 16.
- E. Steel Sections: Zinc-coated (galvanized) steel sheet with G60 zinc coating.
 - 1. Section Thickness: 2 inches.
 - 2. Exterior-Face, Steel Sheet Thickness: 0.016-inch- nominal coated thickness.
 - a. Surface: Manufacturer's standard.
 - 3. Insulation: Foamed in place.
 - 4. Interior Facing Material: Zinc-coated (galvanized) steel sheet with a nominal coated thickness of manufacturer's recommended dimension to comply with performance requirements.
- F. Track Configuration: High Lift.
- G. Weatherseals: Fitted to bottom and top and around entire perimeter of door. Provide combination bottom weatherseal and sensor edge.
- H. Roller-Tire Material: Manufacturer's standard.

- I. Locking Devices: Equip door with locking device assembly.
 - 1. Locking Device Assembly: Single-jamb side locking bars, operable from inside and outside, with cylinders.
- J. Counterbalance Type: Torsion spring.
- K. Electric Door Operator:
 - 1. Usage Classification: Heavy duty, 25 or more cycles per hour and more than 90 cycles per day.
 - 2. Operator Type: Jackshaft, center mounted.
 - 3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use.
 - 4. Motor Exposure: Interior, clean, and dry.
 - 5. Emergency Manual Operation: Chain type.
 - 6. Obstruction-Detection Device: Automatic photoelectric sensor.
 - 7. Control Station: Interior-side mounted.
- L. Door Finish:
 - 1. Baked-Enamel or Powder-Coat Finish: Color and gloss as selected by Architect from manufacturer's standard range.
 - 2. Finish of Interior Facing Material: Finish as indicated by manufacturer's designations.

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 STEEL DOOR SECTIONS

- A. Exterior Section Faces and Frames: Zinc-coated (galvanized), cold-rolled, commercial steel (CS) sheet, complying with ASTM A653/A653M, with indicated zinc coating and thickness.
 - 1. Fabricate section faces from single sheets to provide sections not more than 24 inches high and of indicated thickness. Roll horizontal meeting edges to a continuous, interlocking, keyed, rabbeted, shiplap, or tongue-in-groove weather-resistant seal, with a reinforcing flange return.
 - 2. For insulated doors, provide sections with continuous thermal-break construction, separating the exterior and interior faces of door.
- B. Section Ends and Intermediate Stiles: Enclose open ends of sections with channel end stiles formed from galvanized-steel sheet not less than 0.064-inch-nominal coated thickness and welded to door section. Provide intermediate stiles formed from not less than 0.064-inch-thick galvanized-steel sheet, cut to door section profile, and welded in place. Space stiles not more than 48 inches apart.
- C. Provide reinforcement for hardware attachment.

- D. Foamed-in-Place Thermal Insulation: Insulate interior of steel sections with door manufacturer's standard polyurethane insulation, foamed in place to completely fill interior of section and pressure bonded to face sheets to prevent delamination under wind load, and with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E84. Enclose insulation completely within steel sections and the interior facing material, with no exposed insulation.
- E. Interior Facing Material: Zinc-coated (galvanized), cold-rolled, commercial steel (CS) sheet, complying with ASTM A653/A653M, with indicated thickness.
- F. Fabricate sections so finished door assembly is rigid and aligned, with tight hairline joints and free of warp, twist, and deformation.

2.6 TRACKS, SUPPORTS, AND ACCESSORIES

- A. Tracks: Manufacturer's standard, galvanized-steel track system of configuration indicated, sized for door size and weight, designed for lift type indicated and clearances indicated on Drawings, provide complete system including brackets, bracing, and reinforcement to ensure rigid support of ball-bearing roller guides for required door type, size, weight, and loading.
 - 1. Galvanized Steel: ASTM A 653/A 653M, minimum G60 zinc coating.
 - 2. Slope tracks at an angle from vertical or design tracks to ensure tight closure at jambs when door unit is closed.
 - 3. Track Reinforcement and Supports: Galvanized-steel members to support track without sag, sway, and vibration during opening and closing of doors.
 - a. For Vertical Track: Intermittent, jamb brackets attached to track and attached to wall.
 - b. For Horizontal Track: Continuous reinforcing angle from curve in track to end of track, attached to track and supported at points by laterally braced attachments to overhead structural members.
- B. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom and top of sectional door unless otherwise indicated.

2.7 HARDWARE

- A. General: Heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless-steel, or other corrosion-resistant fasteners, to suit door type.
- B. Rollers: Heavy-duty rollers with steel ball-bearings in case-hardened steel races, mounted with varying projections to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Provide 3-inch-diameter roller tires for 3-inch-wide track and 2-inch-diameter roller tires for 2-inch-wide track.

2.8 LOCKING DEVICES

- A. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded deadbolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

1. Lock Cylinders: Cylinders specified in Section 087100 "Door Hardware" and keyed to building keying system.
2. Keys: Three for each cylinder.

2.9 COUNTERBALANCE MECHANISM

- A. Torsion Spring: Counterbalance mechanism consisting of adjustable-tension torsion springs fabricated from steel-spring wire complying with ASTM A229/A229M, mounted on torsion shaft made of steel tube or solid steel. Provide springs designed for number of operation cycles indicated.

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 Type: Unit consisting of electric motor, gears, pulleys, belts, sprockets, chains, and controls needed to operate door and meet required usage classification.
- D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated.
 1. Electrical Characteristics:
 - a. Phase: Single
 - b. Volts: 115
 - c. Hertz: 60.
 2. Motor Size: Minimum size as indicated. 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.
 3. Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
 4. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
 5. Use adjustable motor-mounting bases for belt-driven operators.
- E. Limit Switches: Equip 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 Device: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.
 - 1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.
 - a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, door closes only with sustained pressure on close button.
- 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, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
- H. Emergency Manual Operation: Equip electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.
- I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- J. 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's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" 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 STEEL AND GALVANIZED-STEEL FINISHES

- A. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, 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 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 sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Tracks:
 - 1. Fasten vertical track assembly to opening jambs and framing, spaced not more than 24 inches apart.
 - 2. Hang horizontal track assembly from structural overhead framing with angles or channel hangers attached to framing by welding or bolting, or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.
- C. Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.
- D. Power-Operated Doors: Install according to UL 325.

3.3 STARTUP SERVICES

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust doors and seals to provide weather-resistant fit around entire perimeter.
- D. Touch-up Painting: Immediately after welding galvanized materials, clean welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A 780/A 780M.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional doors.

END OF SECTION 083613

SECTION 084113 - 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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Exterior and interior storefront framing.
- 2. Exterior manual-swing entrance doors and door-frame units.

B. Related Sections:

- 1. Section 088000 "Glazing."

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.

B. Shop Drawings: For aluminum-framed entrances and storefronts. 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 aluminum-framed entrances and storefronts, showing the following:
 - a. Joinery, including concealed welds.
 - b. Anchorage.
 - c. Expansion provisions.
 - d. Glazing.
 - e. Flashing and drainage.
- 3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

D. Entrance Door Hardware Schedule: Prepared by or under 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.

1.4 INFORMATIONAL SUBMITTALS

- A. Energy Performance Certificates: For aluminum-framed entrances and storefronts, accessories, and components, from manufacturer.
 - 1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront.
- B. Product Test Reports: For aluminum-framed entrances and storefronts, for tests performed by a qualified testing agency.
- C. Source quality-control reports.
- D. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For aluminum-framed entrances and storefronts 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. 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 change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.7 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace components of aluminum-framed entrances and storefronts 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 created by wind and thermal and structural movements.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - d. Water penetration through fixed glazing and framing areas.
 - e. Failure of operating components.

2. Warranty Period: Two years from date of Substantial Completion.
- B. 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: 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 aluminum-framed entrances and storefronts.
- B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure 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.
- C. Design Wind Loads: Determine design wind loads applicable to the Project from basic wind speed indicated in miles per hour, according to ASCE 7, Section 6.5, "Method 2 - Analytical Procedure," based on mean roof heights above grade indicated on Drawings.
 1. See Drawings for loads.
- D. Deflection of Framing Members: At design wind pressure, as follows:
 1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.

2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch, whichever is smaller.
 - a. Operable Units: Provide a minimum 1/16-inch clearance between framing members and operable units.
 - E. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:
 1. Fixed Framing and Glass Area:
 - a. Maximum air leakage of 0.06 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft.
 2. Entrance Doors:
 - a. Pair of Doors: Maximum air leakage of 1.0 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.
 - b. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.
 - F. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:
 1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft.
 - G. Seismic Performance: Aluminum-framed entrances and storefronts shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 1. Seismic Design Category: See Drawings.
 - H. Energy Performance: Certify and label energy performance according to AAMA 1503 as follows:
 1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.47 Btu/sq. ft. x h x deg F.
 2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.35.
 3. Condensation Resistance: Fixed glazing and framing areas shall have a condensation resistance rating of no less than 70.
 - I. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- 2.2 MANUFACTURERS
- A. Basis-of-Design Product: Subject to compliance with requirements, provide Kawneer North America, Trifab® VG 451T framing system or comparable product by one of the following:

1. Arcadia, Inc.
2. Arch Aluminum & Glass Co., Inc.
3. CMI Architectural.
4. Commercial Architectural Products, Inc.
5. EFCO Corporation.
6. Leed Himmel Industries, Inc.
7. Oldcastle BuildingEnvelope.
8. Pittco Architectural Metals, Inc.
9. TRACO.
10. Tubelite.
11. United States Aluminum.
12. YKK AP America Inc.

- B. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing spandrel panels and accessories, from single manufacturer.

2.3 FRAMING

- A. Framing Members: Manufacturer's 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.
4. Finish: Clear anodic finish.
5. Fabrication Method: Field-fabricated stick system.

- B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

- D. Materials:

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - a. Sheet and Plate: ASTM B 209.
 - b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
 - c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
 - d. Structural Profiles: ASTM B 308/B 308M.
2. 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.
 - a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 - b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
 - c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.4 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
 - 1. Door Construction: 2-1/4-inch overall thickness, with minimum 0.125-inch- thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated, and fillet welded or that incorporate concealed tie rods.
 - a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.
 - 2. Door Design: Wide stile; 5-inch nominal width.
 - 3. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.
 - a. Provide nonremovable glazing stops on outside of door.

2.5 ENTRANCE DOOR HARDWARE

- A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."
- B. General: Provide entrance door hardware for each entrance door to comply with requirements in this Section.
 - 1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products equivalent in function and comparable in quality to named products.
 - 2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
 - 3. Opening-Force Requirements:
 - a. Egress Doors: Not more than 15 lbf to release the latch and not more than 30 lbf to set the door in motion and not more than 15 lbf to open the door to its minimum required width.
 - b. Accessible Interior Doors: Not more than 5 lbf to fully open door.
- C. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:
 - 1. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.
- D. Pivot Hinges: BHMA A156.4, Grade 1.
 - 1. Offset-Pivot Hinges: Provide top, bottom, and intermediate offset pivots at each door leaf.
- E. Mortise Auxiliary Locks: BHMA A156.5, Grade 1.

- F. Automatic and Self-Latching Flush Bolts: BHMA A156.3, Grade 1.
 - G. Panic Exit Devices: BHMA A156.3, Grade 1, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
 - H. Cylinders: As specified in Section 087100 "Door Hardware."
 - 1. Keying: Master key system. Permanently inscribe each key with a visual key control number and include notation "DO NOT DUPLICATE".
 - I. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.
 - J. Operating Trim: BHMA A156.6.
 - K. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to comply with field conditions and requirements for opening force.
 - L. Concealed Overhead Holders: BHMA A156.8, Grade 1.
 - M. Surface-Mounted Holders: BHMA A156.16, Grade 1.
 - N. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.
 - O. Weather Stripping: Manufacturer's standard replaceable components.
 - 1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
 - P. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.
 - Q. Silencers: BHMA A156.16, Grade 1.
 - R. Thresholds: BHMA A156.21, raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch.
- 2.6 GLAZING
- A. Glazing: Comply with Section 088000 "Glazing."
- 2.7 ACCESSORIES
- A. 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. When using exposed fasteners, use countersunk Phillips screw heads, finished to match framing system.
- B. 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.
 1. 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 requirements.
- C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- D. 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. 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. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. 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.
 2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.
- F. 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.

- G. 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.
- H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

- A. 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.

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. Seal perimeter and other joints watertight unless otherwise indicated.
- B. Metal Protection:
 - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
 - 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 "Joint Sealants" to produce weathertight installation.
- 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 Section 088000 "Glazing."
- G. 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.

3.3 ERECTION TOLERANCES

- A. Erection Tolerances: Install aluminum-framed entrances and storefronts 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.

END OF SECTION 084113

SECTION 087100 DOOR HARDWARE**PART 1 - GENERAL****1.1 DESCRIPTION OF WORK**

Work under this section comprises the furnishing and installation of finish and security hardware specified herein and noted on drawings for a complete and operational system, including any electrified door hardware components including finish and security hardware and auto operators for aluminum entrance doors, FRP doors, and wood doors.

Items include but are not limited to the following:

Hinges: Butt-type and Continuous

Flush Bolts: Manual and Automatic

Exit Devices

Locksets and Cylinders

Push Plates - Pulls

Coordinators

Closers / ADA Operators

Kick, Mop and Protection Plates

Stops, Wall Bumpers, O.H. Controls

Thresholds, Gasketing and Door Bottoms

Silencers

Miscellaneous Trim and Accessories

Electrified Hardware Items, Controls and Power Supplies

1.2 RELATED DOCUMENTS

Drawings and general provisions of contract, including General and Supplementary conditions and Division 1 specifications sections apply to this section.

1.3 RELATED WORK

Work specified elsewhere that should be examined for its effect upon this section.

Section 081113, Hollow Metal Doors and Frames

Section 081416, Flush Wood Doors

Section 084113, Aluminum-Framed Entrances and Storefront

Section 088000, Glazing

Section 088813, Fire-Resistant Glazing.

Division 26 Electrical.

Division 28 Electronic Safety and Security.

Division 1 Alternates.

1.4 REFERENCES SPECIFIED in this section subject to compliance by:

NFPA-80-2013 - Standard for Fire Doors and Windows.

NFPA-101- Life Safety Code as adopted.

NC Electrical Code – 2014, effective as April 2016.

ADA - The Americans with Disabilities Act - Title III - Public Accommodations

ANSI-A117.1-1992 American National Standards Institute - Accessible and Usable Buildings and Facilities

ANSI-A156.5-American National Standards Institute - Auxiliary Locks and Associated Products

UL 10 C – UBC 7.2 – Positive Pressure Testing

ANSI-A250.6-1997/SDI -107" Hardware on Steel Doors" (reinforcement- application).

Architectural Woodwork Institute (AWI)

International Building Code as Adopted / NC Building Code as adopted

U.L. - Underwriter's Laboratories

WHI - Warnock Hersey International, Division of Intertek Testing Services

State and Local Codes including Authority Having Jurisdiction.

1.5 SUBMITTALS

Shop Drawings: Indicate door and frame elevations and sections, materials, gauges, finishes, door thickness, door swing, stile and rail dimensions, veneers, undercuts, fabrication and erection details, locations of finish hardware by dimension and locations/details of all openings and louvers. Do not proceed with any fabrication until all details are approved.

Hardware Schedule: Submit copies of schedule in accordance with Division 1 – “Submittals“, General Requirements. Schedule to be in vertical format, listing each door opening, including: Keying Information, handing of opening, all hardware scheduled for each opening or otherwise required to allow for proper function of door opening as intended, and finish of the hardware. At doors with door closers or door controls include degree of door opening. All submittals (schedules, cut sheets, wiring diagrams, operational descriptions and elevation drawings) shall be reviewed and approved by the UNCW Project Manager and by the UNCW Locksmith Supervisor Physical Plant. UNCW Business Applications shall review the submittal for electrified hardware applications, along with the wiring diagrams. These submittals shall be approved by UNCW prior to ordering of materials. The Hardware Supplier shall submit the schedules and all templates within three (3) weeks from the date the purchase order is received from the GC.

Manufacturer’s Catalog Cuts: Submit manufacturer's cut/catalog sheets on all hardware items and any required special mounting instructions with the hardware schedule.

Certification of Compliance: Submit any information necessary to indicate compliance to these specifications.

Wiring Diagrams: Provide complete wiring diagrams for each opening requiring electrified hardware. Provide a copy with each hardware schedule submitted after approval. Supply a copy with delivery of hardware to job site and another copy to the Owner at time of job completion. All electrical components shall be listed by opening, in the hardware submittals.

Operational Descriptions: Provide complete operational descriptions of electronic components listed by opening in the hardware submittals. Operational descriptions to detail how each electrical component functions within the opening including all conditions of ingress and egress. Provide a copy with each hardware schedule submitted for approval. Supply another copy with delivery of hardware to job site and another copy to owner at time of job completion.

Elevation Drawings: Provide elevation drawings of electronic hardware and systems identifying locations of the system components with respect to their placement in the door opening. Provide a copy with each hardware schedule submitted for approval. Supply another copy with delivery of hardware to job site and another copy to the Owner at time of job completion.

1.6 QUALITY ASSURANCE

Door Openings Supplier shall be a qualified direct distributor of products to be furnished. In addition, the distributor shall have in their regular employment an A.H.C./C.D.C. or person of equivalent experience, who will be available at reasonable times to consult with the Architect/Contractor and/or Owner regarding any matters affecting the door opening assembly.

All hardware used in labeled fire or smoke rated openings to be listed for those types of openings and bear the identifying label or mark indicating UL (Underwriter's Laboratories) or Warnock Hersey (WHI) approved for fire. Exit Devices. Non-labeled openings to be listed for panic application.

Pre-Installation Meetings: The Contractor shall initiate and conduct a jobsite meeting with the supplier and installer, and all related trades for mechanical hardware, and a meeting for Electronic Hardware. This meeting shall convene at least one month prior to commencement of the related work. All approved shop drawings and schedules shall be made available to all related trades as required for work to be performed. Prior to installation of wiring, and installation of power supplies for electronic hardware, arrange conference between supplier, installers and related trades to review materials, procedures, review door opening functions, and coordinating related work. The Owner's Construction Project Manager and the Locksmith Supervisor -Physical Plant shall attend all pre-install meetings. The Owner's Construction Project Manager, and the Business Applications Services representative.

All hardware products furnished to the project, shall be furnished by an authorized distributor of each product to insure quality compliance, service, and warranty of the products. Product representatives of the following products: Locksets, Closers, Exit Devices, Electrified Hardware, shall conduct a certified training session at the pre-install meeting for product installation training.

All closers and exit devices shall be mounted to doors with the manufacturer's recommended sex-nut/through-bolt fasteners.

Keying Conference: A keying Conference shall be conducted at least 30 days after approval of all hardware submittals on each Building Project. Attendance to this conference shall be: UNCW

Construction Project Manager, the area Department Heads, the UNCW Locksmith -Physical Plant and the Schlage Key representative.

1.7 DELIVERY, STORAGE AND HANDLING

Finish Hardware

Furnish all hardware with each unit clearly marked and numbered in accordance with the hardware schedule. Include door and item number for each.

Pack each item complete with all necessary parts and fasteners.

Properly wrap and cushion each item to prevent scratches and dents during delivery and storage.

Inventory hardware jointly with the General Contractor, Hardware Distributor and Installer until each is satisfied that all products and counts are correct. Any shortages shall be replaced immediately.

The General Contractor shall provide secure lock up in a clean, dry, well-lit space for finish and security hardware storage as delivered to the Project. Control handling and installation of hardware and security items to insure the installation will not be delayed due to hardware losses, both before and after installation.

Hardware shipped to the jobsite is to be packaged in biodegradable packs such as paper or cardboard boxes and wrapping. If non-biodegradable packing such as plastic, plastic bags or large amounts of styrofoam is utilized, then the Contractor will be responsible for the disposal of the non-biodegradable packing to a licensed or authorized collector for recycling of the non-biodegradable packing.

The Manufacturers' Representative and Owners Representative will make several inspections of the installation of Finish and Security Hardware during that phase of construction. Any deficiencies in installation of all products in this Section shall be corrected before installation continues.

1.8 SEQUENCING AND SCHEDULING

Deliver all openings components to the job site in a timely manner so not to delay progress of other trades.

1.9 WARRANTY

Hardware Warranty: Part of respective manufacturers' regular terms of sale. Provide manufacturers' warranties:

Hinges: Life of the building.

Mortise Locksets shall carry manufacturer's 3-year warranty against manufacturing defects and workmanship.

Door closers shall carry manufacturer's 30-year warranty against manufacturing defects. Exit devices shall carry manufacturer's 3-year warranty against manufacturing defects and workmanship.

Continuous gear hinges shall carry manufacturer's Lifetime warranty to be free from defects in material and workmanship.

ADA operators shall carry manufacturer's 2-year warranty against manufacturing defects and workmanship.

Balance of items shall carry a manufacturer's 1-year warranty against manufacturing defects and workmanship.

During the warranty period, replace defective work, including labor, materials and other costs incidental to the work. Inspect the work within 24 hours after receipt of notice from the UNCW Construction Project Manager.

PART 2 - PRODUCTS

2.1 GENERAL

Furnish finish hardware with all necessary screws, bolts and other fasteners of suitable size and type to anchor the hardware in position for a long life under hard use.

Furnish fastenings where necessary with expansion shields, toggle bolts and other anchors designated by the Architect according to the material to which the hardware is to be applied and the recommendations of the hardware manufacturer. **All door closers and exit devices shall be thru-bolted mounted.**

All thresholds shall be fastened with machine screws and anchors. Where specified in the hardware sets, security type fasteners of the type called for are to be supplied.

Design of all fastenings shall harmonize with the hardware as to material and finish.

Provide products as hereafter specified. Substitutions other than those manufacturers listed a Approved Equals must be approved, in writing, via addenda, prior to bid. Procedure for substitutions shall be as outlined in Division 1. No substitutions will be considered after award of contract.

2.2 HINGES

Provide full mortise type, five knuckle exposed tip design ball bearing hinges as specified. Continuous Geared Hinges shall be furnished for all exterior doors with card reader applications and at all Storefront and FRP type doors. Continuous Hinges shall be furnished at any interior door as directed by the Project Manger during the project review. Verify all continuous hinge applications. Unless otherwise scheduled, the required weight, size and hinge type shall be as follows:

Butt hinges required per door leaf:

Doors up to 5'0" in height	2 hinges
Doors over 5'0" to 7'6" in height	3 hinges
Doors over 7'6" to 9'0" in height	4 hinges

Size and weight requirements:

Doors over 36" in width, shall have extra-heavy weight hinges, 5 inches in width.
At exterior openings, hinge pins shall be stainless steel.

Finish: Except as otherwise indicated, provide all hinges with the following finish:

Exterior US32D (630) Satin Stainless Steel

Interior US26D (652) Satin Chrome

Approved Butt Hinge Manufacturers: Ives, McKinney, Hager

Approved Continuous Geared Hinge Manufacturer: Select, Ives, McKinney. **At exterior doors with card reader function, the continuous hinge shall be as Select 11HD EMS/CTW-8 RP (removable panel).**

2.3 LOCK CYLINDERS AND KEYING

General: Provide ten (10) temporary keyed construction cores for the contractor's use during the construction period of the project. Furnish keyed construction cores at all exterior doors, including the cylinder dogging at exit devices. Balance of locks/cylinders may be furnished with factory produced plastic plugs. Construction control and operating keys and cores shall not be part of the Owner's permanent keying system, or furnished on the same keyway as the Owner's permanent keying system. Permanent cores and keys shall be keyed to the approved keying schedule. All cylinders shall be Everest 7-pin, interchangeable core and keyed to existing patented Factory-Registered Grand Masterkey System.

Permanent keys and cores shall be stamped with applicable key mark for identification. These visual key control codes shall not include the actual key cuts. Permanent keys/key blanks will also be stamped "Do Not Duplicate."

The Owner's existing key system: "Schlage", with the specific keyway to be determined by the Owner, and with the Schlage Key representative.

Furnish keys in the following quantities:

- 2 each Master keys per set
- 3 each Change Keys per keyed core or keyed group. Do not cut keys for any exterior door cylinders where the UNCW card reader function is specified.
- 2 each Construction Master keys
- 3 each key blanks per core

At project completion, the UNCW Locksmith Shop shall install the permanent keyed cores. All construction cores and keys shall be returned to the University Construction Project Manager for return the hardware supplier. All permanent keyed cores, keys, and key blanks shall be delivered directly to the Owner from the hardware supplier via Registered Delivery, Return Receipt Required.

2.4 LOCKS, LATCHES AND BOLTS

Mortise Lock and Latches shall be as manufactured by Schlage, series L9000, Grade 1. Trim design shall be as manufactured by Schlage, 17N. Finish shall be: 626 (US26D), unless otherwise noted. Locksets and Latchsets shall be UL listed for use on fire doors. Furnish latch bolts with ¾" minimum throw. Deadbolts shall have 1" throw. All strikes shall be curved lip. Lock function at all instructional/classroom door shall include a thumb-turn and an indicator on the inside trim to indicate the status of the outside trim: locked/unlocked. Acceptable manufacturers: Schlage L series; Falcon M series; Best 42H series.

Provide knurled levers or abrasive strips to all rooms that are considered hazardous, in order to comply with the North Carolina Building Code requirements. This includes but is not limited to all electrical, mechanical and telecommunications rooms.

Auxiliary Locks shall be Grade 1, as scheduled.

Padlocks: Provide a hardware set for each project to include the following padlock as manufactured by: Schlage KS41F1200 x less core x 2" shackle. Verify with the Owner's Construction Project Manager for the quantity required for each project. The Owner will not accept an "add" change order for padlocks not include with the Hardware Submittal.

Cylinders used in any locking mechanism such as in Rolling/Overhead/Coiling Doors, or for a remote Key Switch, shall be furnished with a Schlage Everest 7-pin SFIC housing and keyed core, and follow the UNCW keying requirements listed per Section 2.3 of this document.

Locksets at all teaching spaces shall include a classroom locking function with a thumb-turn and an indicator.

2.5 CLOSERS

General: One manufacturer for closer units throughout the Project Work, including surface closers, overhead-concealed closers, and electromagnetic hold-open closers.

Size of Units: Except as otherwise specifically indicated, comply with the manufacturer's recommendations for size of door control unit, depending upon size of door, exposure to weather and anticipated frequency of use.

Surface Closers:

Door Closers shall be heavy-duty type, Grade 1 with thirty-year warranty.

Cylinders shall be cast iron with forged 1 ½" diameter steel.

Closer main arm shall be forged on all closers. Parallel arms shall be rigid forearms.

Shaft/Pinion shall be 11/16" diameter shaft and double heat-treated.

All closers shall have "all-weather" hydraulics to operate in temperatures from -30degrees to 120 degrees F. without valve adjustments and conforms to positive pressure fire test standards UL10C & UBC 7-2.

All stop arm and spring stop arm closers shall have bronze bushings and shoulder bolts. Where stop type arm is specified, closer shoe shall have a cast-in solid stop. Where spring stop arm is specified, arm shall provide an additional five-degree cushion.

Closers shall be certified by an independent testing laboratory to Ten Million (full load) cycles.

Closers shall be ISO 2000 certified. Units shall be stamped with date-of-manufacture code.

Closers shall be thru-bolt mounted.

Provide plates, brackets and special templating as specified and per manufacturer's recommendation.

Spring power shall be continuously adjustable over the full range of closer sizes and allow for reduced opening force for the physically handicapped.

Acceptable manufacturers: LCN 4111/4011 series; Norton 7501PR series w/ extra duty forged arms; Sargent 281 series with extra duty forged arms.

Pressure relief valves are not acceptable.

2.6 EXIT DEVICES

General: All devices shall be the products of one manufacturer to provide for proper installation and servicing. Devices shall be furnished non-handed and capable of direct field conversion of all available trim functions. All devices shall carry a three-year warranty against manufacturing defects and workmanship.

Furnish all devices with stainless steel touch bars. Plastic parts are not acceptable.

Furnish all exit devices with deadlocking latchbolts or guarded latch (GL) feature.

Furnish all exit devices with flush, cast metal end caps.

Furnish built-in damping / silencing feature. Furnish heavy duty, chassis mounted design with removable cover to eliminate the need to remove the device from the door for maintenance or cylinder change out. Device springs shall be compression type only. Torsion springs are not acceptable.

Furnish roller strikes with all exit devices.

Furnish stabilizers similar to Von Duprin 154 with keyed locking feature at all removable mullions.

All Exit Devices and mullions shall be from one manufacturer.

All latchbolts shall be deadlocking. Latchbolts shall be moly-coated.

Lever trim shall be solid cast material with a break-away feature to limit damage to the unit from vandalism.

Exit devices at instructional/classrooms shall include a thumb-turn and indicator on the device head.

Acceptable Manufacturer: Von Duprin 99/98 series devices; Precision 2100 series x deadlocking latchbolts and roller strikes; Sargent 19-43-GL-80 series with deadlocking latchbolts and roller strikes. Keyed removable mullions shall be as manufactured by Von Duprin KR4954/9954 series, and shall include stabilizer kits. Mullion shall be by the same manufacturer as the exit device.

Surface Vertical Rod devices are not acceptable.

Concealed exit device application shall be concealed cable device and only as approved by the UNCW Locksmith. Concealed cable device shall include the option for less bottom cable, electrified options as required for card reader applications, fire-rating as required by the door, and out-side trim options which match the rim devices.

Electrified functions shall be specified and furnished as Request to Exit and Electric Latch Retraction (QEL-RX-LC). Each opening specified with Request to Exit and Electric Latch Retraction shall be specified and furnished with a PS914-4RL power supply box. The power supply boxes and electrified exit devices shall be by the same manufacturer. Power supply box shall have a regulated output, field selectable for either 24VDC @2 amps or 12VDC @ 4amps. The input shall be universal at 120VAC @ 1 amp or 240VAC @ 0.5amp. The option board compatibility shall include 2 relay QEL panic device control

board. The power supply shall have five (5) knockout holes for conduit connection with a terminal block that handles up to 14 gauge size wire.

2.7 DOOR TRIM UNITS

Fasteners: provide manufacturers standard exposed fasteners for door trim units (kick plates, edge trim, viewers, knockers, mail drops and similar units): either machine screws or self-tapping screws.

Fabricate edge trim of stainless steel, not more than ½" nor less than 1/16" smaller in length than door dimension.

Fabricate protection plates (armor, kick or mop) not more than 2" less door width on stop side and not more than 1" less door width on pull side X the height indicated.

Metal Plates: Stainless Steel .050" (U.S.18ga.), unless otherwise specified.

Approved Manufacturers: Ives/ Hiawatha/Trimco

2.8 MISCELLANEOUS

Provide manual or automatic flush bolts, including coordinators and mounting brackets at pairs of doors as specified.

Generally provide door stops or controls at each door leaf. Provide wall, floor, or stops and holders as specified.

Provide OH Controls, stops or holders as specified.

Approved Manufacturers: Ives/ Glynn Johnson/ Rixson

2.9 THRESHOLDS /WEATHERSTRIP

General: Except as otherwise indicated, provide continuous weatherstripping at each edge of every exterior door leaf. Provide type, size and profiles shown or specified. Provide non-corrosive fasteners as recommended by manufacturer for application intended. Except as otherwise indicated provide ADA standard aluminum thresholds of type, size and profile specified.

Replaceable Seal Strips: Provide only those units where resilient or flexible seal strip is easily replaceable and readily available from manufacturers stock.

Acceptable Manufacturers: National Guard/Reese/Zero.

Provide thresholds that are 1" wider than frame depth. Unless return closed ends are specified, furnish thresholds 2" longer than the opening width for notching around the frame. Hardware installer shall be responsible for notching thresholds to the frame by field measuring after the door opening assembly is installed.

2.10 DOOR SILENCERS

At all hollow metal frames furnish gray resilient rubber silencers. Quantity: Three each at single door openings; two each at double door openings.

2.11 KEY LOCK BOX

Furnish one each secure storage box for emergency personnel use. This box shall be located per the architect and fire marshal at the exterior of the building.

Dual Lock Model, Recessed Mount, 1/4" plate steel housing, 5/8" thick steel door with interior gasket seal. Vault and Lock UL listed. Lock has 1/8" dust cover with tamper seal mounting capability. Vault has anti-theft re-locking mechanism with drill resistant hard-plate lock protector.

Acceptable Manufacturers: Knoxbox 3200

2.12 ELECTRIFIED HARDWARE FUNCTIONS

General: Operation of the card reader access control system shall be managed by the UNCW Business Applications Department. *Card readers, credentials, monitoring, alarms shall be furnished under Division 28. Refer to the current UNCW Standards & Procedures for Installation of Access Control Equipment by UNCW Physical Security & Access Department.*

Where specified in the Finish and Security Hardware Sets openings shall be furnished with all materials listed to provide the security function and control required by the Owner.

The door function shall be as specified in the Part 3 – Hardware Sets. Finish Hardware submittals shall include operational descriptions and wiring diagrams for all electrified hardware functions.

Card reader equipment shall be provided and installed by the Division 28 subcontractor. All electrical applications specified shall be confirmed by review with the UNCW Physical Security & Access Department.

All exterior building entry doors shall be specified with one or more of the above listed electrical functions, or the openings shall be specified with provision for future card readers and electrified hardware.

2.13 OWNERS SERVICE AND STOCK ITEMS

Provide four (4) Final Field use Finish and Security Hardware Schedules with Cut Sheets, Service Instructions and any materials pertinent to the service and maintenance of the Hardware and Systems.

Provide four (4) Sets of all Electrical Drawings illustrating Riser and Point-to-Point Diagrams.

PART 3 - EXECUTION

3.1 INSTALLATION

Mount hardware units at heights indicated in the following applicable publications, except as specifically indicated or required to comply with governing regulations and except as otherwise directed by the Architect. Mounting Height of exit devices, with the exception of full glass aluminum doors, shall not interfere with lite kits shown on elevations. "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute.

Install each hardware item in compliance with the manufacturer's instructions and recommendations. Install with only fasteners furnished with each hardware item, or exact match if additional

fasteners are required. Any substitute fastener shall be approved by UNCW Locksmith Supervisor prior to installation. Where cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation or application of surface protection with finishing work specified in the Division 9 Section. Do not install surface mounted items until finishes have been completed on the substrates involved.

Gaskets: install jamb-applied gaskets before door closers, overhead stops, rim strikes, etc. Install sweeps across bottoms of doors before astragals. Trim astragals to tops of sweeps.

Locate floor stops not more than 4 inches from the wall.

Drill pilot holes for fasteners in wood doors and/or frames.

Thru-Bolts: All closers and exit devices.

Set units level, plumb, and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

Set thresholds for exterior doors in full bed of butyl rubber or polyisobutylene mastic sealant complying with requirements specified in Division 7 Section "Joint Sealers".

Weatherstripping and Seals: Comply with manufacturer's instructions and recommendations to the extent installation requirements are not otherwise indicated.

Instruct Owner's personnel in the proper adjustment and maintenance of door hardware and hardware finishes.

Certified installers: Contractor's personnel, and Section 087100 supplier/installer shall be certified prior to installation of exit devices, locksets, closers, and electrified hardware, including ADA operators, electric strikes, electrified hinges, electric exit devices, and electric door releases. Certification shall be obtained by attendance of manufacturer's training at the pre-install meeting. The manufacturer's representative shall provide written certification to the installers and a copy of the certification shall be provided to the Contractor, the University Construction Project Manager, and the University Locksmith Supervisor. Hardware Installers working on the project site not certified by attending the above specified training, shall be removed from the project site.

All conduit, outlet and backboxes, provisions for 120VAC power, wiring types required for access control system, pulling of correct wiring to appropriate locations, fire alarm system installation and interface, coordination of electrical applications shall be furnished by the Electrical Contractor (Division 26).

3.2 ADJUST AND CLEAN

Adjust and check each operating item of hardware and system of each door to ensure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application made.

Clean adjacent surfaces soiled by Hardware Installation. Avoid the use of caustic cleaners which may mar the finish of the Hardware.

Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy of a space or area, return to work one week before final acceptance and make final check and adjustment of all hardware in such space or area. Clean operating items as necessary. Adjust door controls after HVAC Test and Balance to insure proper door control.

Instruct Owners Personnel in the proper adjustment and maintenance of Hardware and Systems during the final adjustment period.

Continued Maintenance Service: Approximately six (6) months after acceptance of the Project, the Installer, accompanied by the Owners representative and the Finish and Security Hardware Representative(s) shall return to the project and survey the project, readjusting any items as required to restore the hardware to its original function. Replace any failed products failed due to faulty design, materials or installation. Prepare and deliver to the Owners representative a written report of any potential problems in the performance of the hardware with recommended service procedures to insure continued correct function of the products.

3.3 INSPECTION

Door Hardware Supplier's Field service:

Inspect door hardware items for correct installation and adjustment prior to Owner's permanent core installation. The hardware installer shall be present for this inspection. The Owner shall give written notice to the Contractor 5 days prior to inspection. The Hardware Supplier shall submit a written report of the inspection, including any exceptions noted during the inspection, to the Contractor, Architect, the University Construction Project Manager, and the University Locksmith Supervisor.

The Hardware Installer Shall reply to the inspection report within three (3) working days after the inspection report. The Installer's response shall include a list of the required repairs or alterations, and the date the repair work shall be performed. All repairs, and or alterations shall be performed with one week after the Installer's response report.

The written inspection report and the Installer's repair report shall become part of the Contractor's punch list report. All reports shall be submitted to the project architect, and the University Construction Project Manager.

3.4 HARDWARE SETS

Access Control System equipment, including card readers, wiring, connections, and any system related work shall be provided by others. All Electrical work shall be by Div. 26.

HARDWARE GROUP NO. 01

Provide each RU door(s) with the following:

<u>QTY</u>	<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
	NOTE	HARDWARE BY DOOR SUPPLIER		

HARDWARE GROUP NO. 02

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	L9070BDC 17N	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV29 R	626	SCH
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	870AA-S	AA	ZER
1	EA	DOOR BOTTOM	369AA	AA	ZER
1	EA	THRESHOLD	63A-223	A	ZER

HARDWARE GROUP NO. 03

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PASSAGE SET	L9010 17N	626	SCH
1	EA	OH STOP	450S	630	GLY
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER

HARDWARE GROUP NO. 04

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	L9071BDC 17N L283-711	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV29 R	626	SCH
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER

HARDWARE GROUP NO. 05

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	CLASSROOM LOCK	L9071BDC 17N L283-711	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV29 R	626	SCH
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER

HARDWARE GROUP NO. 06

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	CLASSROOM LOCK	L9071BDC 17N L283-711	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV29 R	626	SCH
1	EA	SURFACE CLOSER	4111 CUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE

HARDWARE GROUP NO. 07

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	L9071BDC 17N L283-711	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV29 R	626	SCH
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	870AA-S	AA	ZER
1	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	DOOR BOTTOM	369AA	AA	ZER
1	EA	THRESHOLD	63A-223	A	ZER

HARDWARE GROUP NO. 08

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	STOREROOM LOCK	L9080BDC 17N	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV29 R	626	SCH
1	EA	LOCK GUARD	LG1	630	IVE
1	EA	SURFACE CLOSER	4111 SHCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	429AA-S	AA	ZER
1	EA	RAIN DRIP	142AA	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A-223	A	ZER

HARDWARE GROUP NO. 09

Provide each PR door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
6	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	SET	AUTO FLUSH BOLT	FB41P	630	IVE
1	EA	DUST PROOF STRIKE	DP1	626	IVE
1	EA	CLASSROOM LOCK	L9070BDC 17N	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV29 R	626	SCH
1	EA	COORDINATOR	COR X FL	US26D	IVE
2	EA	SURFACE CLOSER	4111 EDA	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
2	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER

HARDWARE GROUP NO. 10

Provide each PR door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
6	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	SET	CONST LATCHING BOLT	FB51P	630	IVE
1	EA	DUST PROOF STRIKE	DP1	626	IVE
1	EA	STOREROOM LOCK	L9080BDC 17N	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV29 R	626	SCH
1	EA	COORDINATOR	COR X FL	US26D	IVE
2	EA	SURFACE CLOSER	4011	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
2	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	MEETING STILE	383AA	AA	ZER
1	EA	GASKETING	188SBK PSA	BK	ZER

HARDWARE GROUP NO. 11

Provide each PR door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
6	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	SET	CONST LATCHING BOLT	FB51P	630	IVE
1	EA	DUST PROOF STRIKE	DP1	626	IVE
1	EA	STOREROOM LOCK	L9080BDC 17N	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV29 R	626	SCH
1	EA	COORDINATOR	COR X FL	US26D	IVE
2	EA	SURFACE CLOSER	4111 CUSH	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
1	EA	MEETING STILE	383AA	AA	ZER
1	EA	GASKETING	188SBK PSA	BK	ZER

HARDWARE GROUP NO. 12

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	PANIC HARDWARE	LD-98-EO	626	VON
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	EA	GASKETING	429AA-S	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A-223	A	ZER
1	EA	DOOR CONTACT	679-05HM	BLK	SCE

HARDWARE GROUP NO. 13

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	FIRE EXIT HARDWARE	98-L-F-17	626	VON
1	EA	SFIC EVEREST CORE	80-037 EV29 R	626	SCH
1	EA	SFIC RIM CYLINDER	80-159	626	SCH
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	870AA-S	AA	ZER
1	EA	DOOR BOTTOM	369AA	AA	ZER
1	EA	THRESHOLD	63A-223	A	ZER
1	EA	MOUNTING BRACKET	870SPB		ZER
1	EA	GASKETING	188SBK PSA	BK	ZER

HARDWARE GROUP NO. 14

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	630	IVE
1	EA	PANIC HARDWARE	LD-98-NL	626	VON
1	EA	SFIC RIM CYLINDER	80-159	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV29 R	626	SCH
1	EA	SURFACE CLOSER	4111 SHCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	429AA-S	AA	ZER
1	EA	RAIN DRIP	142AA	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A-223	A	ZER

HARDWARE GROUP NO. 15

Provide each PR door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
6	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	FIRE RATED REMOVABLE MULLION	9954	689	VON
1	EA	FIRE EXIT HARDWARE	98-L-F-17	626	VON
1	EA	FIRE EXIT HARDWARE	98-EO-F	626	VON
1	EA	SFIC RIM CYLINDER	80-159	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV29 R	626	SCH
2	EA	SURFACE CLOSER	4111 EDA	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
2	EA	WALL STOP	WS406/407CVX	630	IVE
2	EA	GASKETING	870AA-S	AA	ZER
2	EA	GASKETING	488SBK PSA	BK	ZER
2	EA	DOOR BOTTOM	369AA	AA	ZER
1	EA	THRESHOLD	63A-223	A	ZER
2	EA	MOUNTING BRACKET	870SPB		ZER
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER

HARDWARE GROUP NO. 16

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PUSH PLATE	8200 6" X 16"	630	IVE
1	EA	PULL PLATE	8303 10" 4" X 16"	630	IVE
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE

OPERATIONAL DESCRIPTION: DOORS NORMALLY CLOSED AND UNLOCKED. PUSH/PULL OPERATION.

HARDWARE GROUP NO. 17

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ROLLER LATCH	RL30A	613	IVE
1	EA	PULL PLATE	8303 10" 4" X 16"	630	IVE
1	EA	PUSH PLATE	8200 6" X 16"	630	IVE
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	870AA-S	AA	ZER
1	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	DOOR BOTTOM	369AA	AA	ZER
1	EA	THRESHOLD	63A-223	A	ZER

HARDWARE GROUP NO. 18

Provide each PR door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
6	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
2	EA	PULL PLATE	8303 10" 4" X 16"	630	IVE
2	EA	PUSH PLATE	8200 6" X 16"	630	IVE
2	EA	SURFACE CLOSER	4011	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
2	EA	WALL STOP/HOLDER	FS495	US26D	IVE
1	EA	GASKETING	326AA-S	AA	ZER
1	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	GASKETING	870AA-S	AA	ZER
2	EA	DOOR BOTTOM	369AA	AA	ZER
1	EA	THRESHOLD	63A-223	A	ZER

HARDWARE GROUP NO. 19

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
1	EA	CONT. HINGE	224HD	628	IVE
1	EA	PANIC HARDWARE	LD-98-EO	626	VON
1	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A-223	A	ZER
1	EA	DOOR CONTACT	679-05HM	BLK	SCE
SEALS BY DOOR SUPPLIER					

HARDWARE GROUP NO. 20

Provide each PR door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
2	EA	CONT. HINGE	224HD EPT	628	IVE
2	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	REMOVABLE MULLION	KR4954 STAB	689	VON
1	EA	ELEC PANIC HARDWARE	CD-RX-LC-98-EO-CON	626	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-98-NL-CON-24VDC	626	VON
1	EA	SFIC RIM CYLINDER	80-159	626	SCH
2	EA	PRIMUS MORT. CYL.	20-763 118	626	SCH
3	EA	SFIC EVEREST CORE	80-037 EV29 R	626	SCH
2	EA	OH STOP	100S	630	GLY
2	EA	SURFACE CLOSER	4111 EDA	689	LCN
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A-223	A	ZER
2	EA	DOOR CONTACT	679-05HM	BLK	SCE
1	EA	POWER SUPPLY	PS902 BBK FA900 KL900	LGR	SCE
1	SET	WIRING DIAGRAMS	DOOR ELEVATION AND POINT-TO- POINT		SCE
SEALS BY DOOR SUPPLIER					
CARD READER BY OTHERS					

OPERATIONAL DESCRIPTION: DOOR NORMALLY CLOSED AND LOCKED. AUTHORIZED ACCESS BY VALID CARD READ, WHICH SHUNTS DOOR POSITION SWITCH AND RETRACTS LATCH BOLT, ALLOWING DOOR TO BE PULLED OPEN MANUALLY. IMMEDIATE EGRESS ALWAYS ALLOWED BY DEPRESSING EXIT DEVICE PUSH RAIL, WHICH SHUNTS DOOR POSITION SWITCH, AND RETRACTS LATCH BOLT.

END OF SECTION 087100

SECTION 087113 - AUTOMATIC DOOR OPERATORS

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. Low-energy door operators for swinging doors.

- B. Related Requirements:

- 1. Section 084113 "Aluminum Entrances and Storefronts" for aluminum framing systems associated with automatic door operators.
 - 2. Section 087100 "Door Hardware" for installing related door hardware.

1.3 DEFINITIONS

- A. AAADM: American Association of Automatic Door Manufacturers.
- B. Activation Device: A control that, when actuated, sends an electrical signal to the door operator to open the door.
- C. Safety Device: A control that, to avoid injury, prevents a door from opening or closing.
- D. For automatic door terminology, see BHMA A156.19 for definitions of terms.

1.4 COORDINATION

- A. Templates: Distribute for doors, frames, and other work specified to be factory prepared and reinforced for installing automatic door operators.
- B. Coordinate hardware for doors with operators to ensure proper size, thickness, hand, function, and finish.
- C. Electrical System Roughing-in: Coordinate layout and installation of automatic door operators with connections to the following:
 - 1. Power supplies.
 - 2. Access-control system.

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 for automatic door operators.

2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For automatic door operators.

1. Include plans, elevations, sections, hardware mounting heights, and attachment details.
2. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Indicate locations of activation and safety devices.
4. Include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified, manufacturer's standard size.

1.6 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of automatic door operator.

B. Sample Warranties: For manufacturer's special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For automatic door operators, safety devices, and control systems, to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer for installation and maintenance of units required for this Project.

1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of automatic door operators that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Faulty or sporadic operation of automatic door operator, including controls.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering or use.
2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Besam Entrance Solutions; an ASSA ABLOY Group Company.
 - 2. DORMA USA, Inc.
 - 3. Hager Companies.
 - 4. LCN; an Allegion brand.
 - 5. SARGENT Manufacturing Company; ASSA ABLOY.
- B. Source Limitations: Obtain automatic door operators, including activation and safety devices, from single source from single manufacturer.

2.2 AUTOMATIC DOOR OPERATORS, GENERAL

- A. General: Provide operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for occupancy type indicated; and in accordance with UL 325. Coordinate operator mechanisms with door operation, hinges, and activation and safety devices.
 - 1. Emergency Breakaway: Where indicated for center-pivoted doors, provide emergency breakaway feature for reverse swing of doors. Equip system to discontinue power to automatic door operator when door is in emergency breakaway position, to return door to closed position after breakaway, and to automatically reset.
 - 2. Wind Load: Provide door operators on exterior doors that will open and close doors and maintain them in fully closed position when subjected to wind load of 15psf.
- B. Electromechanical Operating System: Self-contained unit powered by permanent-magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor, connections for power and activation- and safety-device wiring, and manual operation, including spring closing when power is off.
- C. Hinges: See Section 087100 "Door Hardware" for hinge type for each door that door operator shall accommodate.
- D. Cover for Surface-Mounted Operators: Fabricated from 0.125-inch-thick, extruded or formed aluminum; manufacturer's standard width; with enclosed end caps, provision for maintenance access, and fasteners concealed when door is in closed position.
- E. Brackets and Reinforcements: Fabricated from aluminum with nonstaining, nonferrous shims for aligning system components.
- F. 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.

2.3 LOW-ENERGY DOOR OPERATORS FOR SWINGING DOORS

- A. Standard: BHMA A156.19.

B. Performance Requirements:

1. Opening Force if Power Fails: Not more than 15 lbf required to release latch if provided, not more than 30 lbf required to manually set door in motion, and not more than 15 lbf required to fully open door.
2. Entrapment-Prevention Force: Not more than 15 lbf required to prevent stopped door from closing or opening.

C. Configuration: Operator to control single swinging door.

1. Traffic Pattern: One way.
2. Operator Mounting: Surface.

D. Operation: Power opening and spring closing. Provide time delay for door to remain open before initiating closing cycle as required by BHMA A156.19. When not in automatic mode, door operator shall function as manual door closer, with or without electrical power.

E. Microprocessor Control Unit: Solid-state controller.

F. Features:

1. Adjustable opening and closing speed.
2. Adjustable opening force.
3. Adjustable backcheck.
4. Adjustable hold-open time from zero to 30 seconds.
5. Adjustable time delay.
6. Adjustable acceleration.
7. Obstruction recycle.
8. On-off/hold-open switch to control electric power to operator.

G. Activation Device: Push-plate switch on each side of door to activate door operator.

H. Exposed Finish: Class I, clear anodic finish.

2.4 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Extrusions: ASTM B221.
2. Sheet: ASTM B209.

B. Fasteners and Accessories: Corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

2.5 CONTROLS

A. General: Provide controls, including activation and safety devices, in accordance with BHMA standards; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for occupancy type indicated. Coordinate activation and safety devices with door operation and door operator mechanisms.

- B. Push-Plate Switch: Momentary-contact door control switch with flat push-plate actuator with contrasting-colored, engraved message.

- 1. Configuration: Square push plate with 4 1/2-by-4 1/2-inch junction box.

- a. Mounting (interior): Recess mounted, semi-flush in wall.
 - b. Mounting (exterior): Bollard mounted.

- 1) Size: 42-inches tall, 6 1/4-inch by 4 1/4-inch.

- 2. Push-Plate Material: Stainless steel, type 304.

- 3. Message: International symbol of accessibility and "Push to Open."

2.6 ACCESSORIES

- A. Signage: As required by cited BHMA standard for type of door and its operation.

- 1. Application Process: Operator manufacturer's standard process.
 - 2. Provide sign materials with instructions for field application when operators are installed.

2.7 FABRICATION

- A. Factory fabricate automatic door operators to comply with indicated standards.
- B. Form aluminum shapes before finishing.
- C. Fabricate exterior components to drain condensation and water-passing joints within operator enclosure to the exterior.
- D. Use concealed fasteners to greatest extent possible. Where exposed fasteners are required, use countersunk Phillips flat-head machine screws, finished to match operator.

2.8 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying strippable, temporary, protective covering before shipping.
- B. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.
- C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within range of approved Samples and are assembled or installed to minimize contrast.

2.9 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 conditions, with Installer present, for compliance with requirements for installation tolerances, door and frame preparation and reinforcements, and other conditions affecting performance of automatic door operators.
- B. Examine roughing-in for electrical systems to verify actual locations of power connections before automatic door operator installation.
- C. Verify that full-height finger guards are installed at each door with pivot hinges, where door has a clearance at hinge side greater than 1/4 inch and less than 3/4 inch with door in any position.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install automatic door operators in accordance with manufacturer's written instructions and cited BHMA standard for type of door operation and direction of pedestrian travel, including signage, controls, wiring, remote power units if any, and connection to building's power supply.
 - 1. Do not install damaged components. Fit joints to produce hairline joints free of burrs and distortion.
 - 2. Install operators true in alignment with established lines and door geometry without warp or rack. Anchor securely in place.
- B. Controls: Install activation and safety devices in accordance with manufacturer's written instructions and cited BHMA standard for operator type and direction of pedestrian travel. Connect control wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Access-Control System: Connect operators to access-control system as specified in Section 281300 "Access Control System."
- D. Signage: Apply on both sides of each door as required by cited BHMA standard for type of door operator and direction of pedestrian travel.

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Test and inspect each automatic door operator installation, using AAADM inspection forms, to determine compliance of installed systems with applicable BHMA standards.
- B. Automatic door operators will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.4 ADJUSTING

- A. Adjust automatic door operators to function smoothly and lubricate as recommended by manufacturer; comply with requirements of applicable BHMA standards.
 - 1. Adjust operators on exterior doors for tight closure.
- B. After completing installation of automatic door operators, inspect exposed finishes on doors and operators. Repair damaged finish to match original finish.
- C. Readjust automatic door operators and controls after repeated operation of completed installation equivalent to three days' use by normal traffic (100 to 300 cycles).
- D. Occupancy Adjustment: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.5 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of automatic door operator Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 1. Perform maintenance, including emergency callback service, during normal working hours.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain automatic door operators.

END OF SECTION 087113

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 and storefront framing.
 - 2. Glazing sealants and accessories.
- B. Related Requirements
 - 1. See Section 102800 "Toilet, Bath and Laundry Accessories" for glazed mirrors.

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. IBC: International Building Code.
- D. 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. Samples for verification purposes of 12-inch square samples of each type of glass indicated except for clear monolithic glass products, and 12-inch long samples of each color required (except black) for each type of sealant or gasket exposed to view. Install sealant or gasket sample between two strips of material representative in color of the adjoining framing system.
- C. Product certificates signed by glazing materials manufacturers certifying that their products comply with specified requirements.

- D. Compatibility and adhesion test reports from sealant manufacturer indicating that glazing materials were tested for compatibility and adhesion with glazing sealants. Include sealant manufacturer's interpretation of test results relative to sealant performance and recommendations for primers and substrate preparation needed for adhesion.
- E. Compatibility test report from manufacturer of insulating glass edge sealant indicating that glass edge sealants were tested for compatibility with other glazing materials including sealants, glazing tape, gaskets, setting blocks, and edge blocks.
- F. Product test reports for each type of glazing sealant and gasket indicated, evidencing compliance with requirements specified.
- G. Maintenance data for glass and other glazing materials to include in Operating and Maintenance Manual specified in Division 1.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- B. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.
- C. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: GANA's "Laminated Glazing Reference Manual" and GANA's "Glazing Manual."
 - 2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- D. Safety Glazing Labeling: Where safety glazing labeling 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.
- E. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

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.

1.8 PROJECT 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.

1.9 WARRANTY

- A. General: Warranties specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.
 - 1. Warranty Period: Manufacturer's standard but not less than 5 years after date of Substantial Completion.
- B. Manufacturer's Warranty on Laminated Glass: Submit written warranty signed by insulating glass manufacturer agreeing to furnish replacements for those laminated glass units that deteriorate as defined in the "Definitions" article, f.o.b. point of manufacture, freight allowed Project site, within specified warranty period indicated below. Warranty covers only deterioration due to normal conditions of use and not to handling, installing, and cleaning practices contrary to glass manufacturer's published instructions.
 - 1. Warranty Period: Manufacturer's standard but not less than 5 years after date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. 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.
- B. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated.
 - 1. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
 - a. See Drawings for all loads.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glazing framing members and glazing components.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- 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 monolithic-glass lites, properties are based on units with lites 6 mm thick.
2. For laminated-glass lites, properties are based on products of construction indicated.
3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
4. 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.
5. 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.
6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.3 GLASS PRODUCTS, GENERAL

- A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
1. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.
 2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.
- B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened, glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.
- C. 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 monolithic-glass lites, properties are based on units with lites 6.0 mm thick.
 2. For laminated-glass lites, properties are based on products of construction indicated.
 3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 4. 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.
 5. 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.
 6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.4 PRIMARY FLOAT GLASS PRODUCTS

- A. Float Glass: ASTM C 1036, Type I (transparent glass, flat), Class as indicated below, and Quality q3 (glazing select).
1. Class 1 (clear) unless otherwise indicated, all interior windows and interior sheet of insulated exterior windows.

2. Class 2 (tinted, heat-absorbing, and light-reducing) at exterior surface sheets.

B. Performance Characteristics:

1. Primary Tinted Float Glass Class 2: 1/4" thickness
 - a. Tint: Equivalent to PPG Solargray.
 - b. Visible Light Transmittance: 44%.
 - c. Shading Coefficient: .67.
 - d. Outdoor Visible Reflectance: 6%
 - e. U-Value Winter: 1.02.
 - f. U-Value Summer: 0.93.
 - g. Solar Heat Gain Coefficient (SHGC): 0.58.
- C. Refer to requirements for sealed insulating glass units for performance characteristics of assembled units composed of tinted glass, coated or uncoated, relative to visible light transmittance, U-values, shading coefficient, and visible reflectance.

2.5 HEAT-TREATED FLOAT GLASS

- A. Uncoated, Tinted, Heat-Treated Float Glass: ASTM C 1048, Condition C (uncoated glass), Type I (transparent glass, flat), Class 2 (tinted heat-absorbing and light-reducing), Quality q3 (glazing select), with tint color and performance characteristics for 6.0-mm-thick (0.23-inch-thick) glass matching those indicated for annealed primary tinted float glass; kind as indicated below:
 1. Kind FT (fully tempered) where indicated.
- B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering heat-treated glass products that may be incorporated in the Work include, but are not limited to, the following companies.
 1. Advanced Glass Systems Corp.
 2. Guardian Industries Corp.
 3. PPG Industries, Inc.
 4. LOF, Libbey-Owens-Ford Co.
 5. Viracon, Inc.

2.6 INSULATING GLASS PRODUCTS

- A. Sealed Insulating Glass Units: Preassembled units consisting of organically sealed lites of glass separated by dehydrated air spaces complying with ASTM E 774 and with other requirements indicated, including those in Insulating Glass Product Data Sheet at the end of this Section.
 1. For properties of individual glass lites making up units, refer to requirements specified elsewhere in this Section applicable to types, classes, kinds, and conditions of glass products comprising lites of insulating glass units.
 2. Provide heat-treated, coated float glass of kind indicated or, if not otherwise indicated, Kind HS (heat strengthened) where recommended by manufacturer to comply with system performance requirements specified and Kind FT (fully tempered) where safety glass is designated or required.

3. Performance characteristics designated for coated insulating glass are nominal values based on manufacturer's published test data for units with lites 6.0 mm (0.23 inch) thick and nominal 1/2-inch dehydrated space between lites, unless otherwise indicated.
4. U-values are expressed as Btu/hour x sq. ft. x deg F.

B. Construction Characteristics:

1. Air Space Width: Nominal ½ inch measured perpendicularly from surfaces of glass lites at unit's edge.
2. Gas Filling: Fill air space with argon.
3. Sealing System: Dual seal, primary and secondary sealants: manufacturer's standard sealants.
4. Spacer Specifications: Manufacturer's standard.
5. Desiccant: Either molecular sieve or silica gel or blend of both.
6. Corner Construction: Manufacturer's standard corner construction.
7. Color of Spacer: Color as selected by Architect from manufacturer's standard colors.

C. Glass Specifications (storefronts):

1. Insulating glazing on this project shall be Low 'E' coated, tinted outdoor lite, with argon filled cavity. Insulating glazing product shall be equal to PPG Solarban 70XL + Solargray.
2. Thickness of Each Lite: 6.0 mm (0.23 inch).
3. Low E coated Indoor Lite: Class 1 (clear) float glass with coating on #2 surface.
4. Outdoor Lite: Class 2 (tinted, heat-absorbing and light-reducing) float glass with tint color: PPG Solarban 70XL or equivalent.
5. Performance of Insulated Glass: (performance values published are manufacturer's recommended values for insulated glass.)
 - a. Visible light transmission: 34%.
 - b. Shading coefficient: 0.23.
 - c. U-value: 0.28 winter, 0.36 summer.
 - d. Solar Heat Gain Coefficient (SHGC): 0.20.

2.7 LAMINATED GLASS

A. Laminated Glass: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written instructions.
2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
3. Interlayer Color: Clear unless otherwise indicated.

B. Location: at window between Sound Mix 1 (1118) and Sound Mix 2 (1117).

C. Glass Specifications:

1. Glass Type: Clear laminated glass with two plies of ultraclear heat-strengthened float glass.

- a. Minimum Thickness of Each Glass Ply: 6 mm.
- b. Interlayer Thickness: 0.060 inch.

2.8 GLAZING GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
 - 1. Neoprene complying with ASTM C 864.
 - 2. EPDM complying with ASTM C 864.
 - 3. Silicone complying with ASTM C 1115.
 - 4. Thermoplastic polyolefin rubber complying with ASTM C 1115.

2.6 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, 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).

2.7 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.

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.

3.4 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.

3.5 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 Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088000

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 partitions.
 - 2. Grid suspension systems for gypsum board ceilings.
 - 3. Acoustic isolation brackets.

- B. Related Requirements:

- 1. Section 012300 "Alternates" for procedures for alternates.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

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

1.5 QUALITY ASSURANCE

- A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association, the Steel Framing Industry Association or the Steel Stud Manufacturers Association.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E119 by an independent testing agency.

- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
- C. Horizontal Deflection: For wall assemblies, limited to 1/240 of the wall height based on horizontal loading of 5 lbf/sq. ft.

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. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. CEMCO; California Expanded Metal Products Co.
 - b. Clark Dietrich Building Systems.
 - c. Custom Stud.
 - d. MBA Building Supplies.
 - e. MRI Steel Framing, LLC.
 - f. Phillips Manufacturing Co.
 - g. Steel Network, Inc.
 - h. Telling Industries.
- B. Studs and Tracks: ASTM C 645. Use either steel studs and tracks or embossed steel studs and tracks.
 - 1. Steel Studs and Tracks:
 - a. Minimum Base-Metal Thickness: As required by performance requirements for horizontal deflection.
 - b. Depth: As indicated on Drawings.
- C. Slip-Type Head Joints: Where indicated, provide one of the following:
 - 1. Single Long-Leg Track System: ASTM C 645 top track with 2-inch-deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top track and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
 - 2. Deflection Track: Steel sheet top track 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. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 - 1. Minimum Base-Metal Thickness: 0.0296 inch.
- E. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base-Metal Thickness: 0.0296 inch.
 2. Depth: 7/8 inch.
- F. Resilient Furring Channels: 1/2-inch-deep, steel sheet members designed to reduce sound transmission.
- G. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges.
1. Depth: 3/4 inch insert depth.
 2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch.
 3. 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.
- H. Z-Shaped Furring: 0.0179 inch uncoated-steel thickness, with slotted or non-slotted web
1. Face flange of 1-1/4 inches
 2. Wall attachment flange of 7/8 inch
 3. Depth as required to fit insulation thickness indicated.

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.
- 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 (Main Runners): Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch and minimum 1/2-inch-wide flanges.
1. Depth: 2-1/2 inches.
- E. Furring Channels:
1. Cold-Rolled Channels: 0.0538-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.
 2. Steel Studs and Tracks: ASTM C 645.
 - a. Minimum Base-Metal Thickness: 0.0269 inch.
 - b. Depth: 1-5/8 inches.
 3. Embossed Steel Studs and Tracks: ASTM C 645.
 - a. Minimum Base-Metal Thickness: 0.0190 inch.
 - b. Depth: 1-5/8 inches.
 4. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
 - a. Minimum Base-Metal Thickness: 0.0296 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.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong World Industries, Inc.
 - b. Chicago Metallic Corporation.
 - c. United States Gypsum Company.

2.4 ACOUSTIC ISOLATION BRACKETS (Alternate)

- A. Direct fix furring channel resilient mount bracket to reduce airborne vibration and structure vibration.
 - 1. Compatible with both 7/8-inch or 1 1/2-inch furring channels.
- B. Components:
 - 1. Galvanized steel bracket: 0.047-inch thick.
 - 2. Clip height: 1 1/8-inch.
 - 3. Thermoplastic rubber isolator: 3/8-inch thick.
- C. Basis of Design Product:
 - 1. Studco Building Systems, Resilmont A237R.

2.5 AUXILIARY MATERIALS

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.

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

3.4 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Single-Layer Application: 16 inches o.c. unless otherwise indicated.
2. Multilayer Application: 16 inches o.c. unless otherwise indicated.
3. Tile Backing Panels: 16 inches o.c. unless otherwise indicated.

B. Install studs so flanges within framing system point in same direction.

C. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.

1. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch 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.

2. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

D. Direct Furring:

1. Screw to wood framing.

2. 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 CEILING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 1. Hangers: 48 inches o.c.
 2. Carrying Channels (Main Runners): 48 inches o.c.
 3. Furring Channels (Furring Members): 16 inches o.c.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 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. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- E. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

3.6 INSTALLING ACOUSTIC ISOLATION BRACKETS

A. Install in accordance with manufacturer's written instructions and as limited below:

1. Fasten brackets to steel studs with minimum #8 sheet metal screws.
2. Maximum lateral spacing: 48-inches
3. Maximum vertical spacing: 24-inches
4. For fire-rated partitions, use Resilmont A300 washer.

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. Shaft wall liner panels.

B. Related Requirements:

- 1. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.

1.3 ACTION SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

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

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or blotchy 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 E119 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.

2.3 INTERIOR GYPSUM BOARD

- A. Gypsum Wallboard: ASTM C 1396/C 1396M.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. Georgia-Pacific Building Products.
 - c. National Gypsum Company.
 - d. United States Gypsum Company.
 - 2. Thickness: 5/8 inch.
 - 3. Long Edges: Tapered.
- B. Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.
 - 1. Core: 5/8 inch, regular type.
 - 2. Long Edges: Tapered.
 - 3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- C. Gypsum Board, Type X: ASTM C1396/C1396M.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. Georgia-Pacific Building Products.
 - c. National Gypsum Company.
 - d. United States Gypsum Company.
 - 2. Thickness: 5/8 inch.
 - 3. Long Edges: Tapered.

D. Gypsum Board, Shaft Liner Board:

1. Type X: ASTM C1396/C1396M; manufacturer's proprietary fire-resistive liner panels with paper faces, 1 inch thick, with double beveled long edges
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. Georgia-Pacific Building Products.
 - c. National Gypsum Company.
 - d. United States Gypsum Company.

2.4 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325, with manufacturer's standard edges.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. CertainTeed Corporation.
 - b. James Hardie Building Products, Inc.
 - c. National Gypsum Company.
 - d. USG Corporation.
2. Thickness: 1/2 inch or 5/8 inch.
3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.5 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.

2.6 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.

2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
3. Fill Coat: For second coat, use drying-type, all-purpose compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.

2.7 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- C. 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.
- D. 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.
- E. Acoustical 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.
- F. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 APPLYING AND FINISHING PANELS, GENERAL

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

- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch 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. 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 instructions 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. Mold-Resistant Type: Behind tile surfaces.
- 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.
- 3. On Z-shaped 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 partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
 - 2. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

3.4 APPLYING SHAFT LINER BOARD

- A. General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated and manufacturer's written installation instructions.
- B. Penetrations: At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons and floor indicators, and similar items.

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 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.
 - 2. LC-Bead: Use at exposed panel edges.

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 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 Section 099123 "Interior Painting."
- 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. Glazed wall tile.
- 3. Stone thresholds.
- 4. Metal edge strips.

B. Related Requirements:

- 1. Section 079200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
- 2. Section 092900 "Gypsum Board" for cementitious backer units.

1.3 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in its "Specifications for Installation of Ceramic Tile."
- C. Module Size: Actual tile size plus joint width indicated.
- D. Face Size: Actual tile size, excluding spacer lugs.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification:
 - 1. Full-size units of each type and composition of tile and for each color and finish required.

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 and certified porcelain tile.

1.6 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.
 - 2. Installer's supervisor for Project holds the International Masonry Institute's Foreman Certification.

1.7 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.

1.8 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.

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 Type CT-1: Factory-mounted glazed ceramic mosaic tile.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. American Marazzi Tile, Inc.
 - b. American Olean; a division of Dal-Tile Corporation.
 - c. Daltile.
 - 2. Composition: Porcelain.
 - 3. Certification: Porcelain tile certified by the Porcelain Tile Certification Agency.
 - 4. Module Size: 2 by 2 inches.
 - 5. Thickness: 1/4 inch.
 - 6. Face: Plain with cushion edges.
 - 7. Surface: Slip resistant, with abrasive admixture.
 - 8. Dynamic Coefficient of Friction: Not less than 0.42.
 - 9. Finish: Semi-mat, opaque glaze.
 - 10. Tile Color and Pattern: As selected by Architect from manufacturer's full range.
 - 11. Grout Color: As selected by Architect from manufacturer's full range.
 - 12. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. Base Cove: Cove, module size 2 by 1 inch.
 - b. Internal Corners: Field-buttet square corners. For coved base and cap, use angle pieces designed to fit with stretcher shapes.
- B. Ceramic Tile Type CT-2: Glazed wall tile.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. American Marazzi Tile, Inc.
 - b. American Olean; a division of Dal-Tile Corporation.
 - c. Daltile.
2. Module Size: 6 by 6 inches.
3. Face Size Variation: Rectified.
4. Thickness: 5/16 inch.
5. Face: Plain with modified square edges or cushion edges.
6. Finish: Bright, opaque glaze.
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. Mounting: Factory, back mounted.
10. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. Internal Corners: Field-buttet square corners. For coved base and cap use angle pieces designed to fit with stretcher shapes.

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 C 503/C 503M, with a minimum abrasion resistance of 12 according to ASTM C 1353 or ASTM C 241/C 241M and with honed finish.
 1. Description: Uniform, fine- to medium-grained white stone with gray veining.

2.5 SETTING MATERIALS

- A. Latex-Portland Cement Mortar (Thinset): ANSI A118.4.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Ardex Americas.
 2. Boiard Products Corporation; a QEP company.
 3. Bonsal American; an Oldcastle company.
 4. Bostik, Inc.
 5. C-Cure.
 6. Custom Building Products.
 7. Jamo Inc.
 8. Laticrete International, Inc.

9. MAPEI Corporation.
10. Merkrete Systems; Parex USA, Inc.
11. Southern Grouts & Mortars, Inc.
12. Summitville Tiles, Inc.
13. TEC; H. B. Fuller Construction Products Inc.

- C. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
- D. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

2.6 GROUT MATERIALS

- A. High-Performance Tile Grout: ANSI A118.7.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Ardex Americas.
 2. Boiardi Products Corporation; a QEP company.
 3. Bonsal American; an Oldcastle company.
 4. Bostik, Inc.
 5. C-Cure.
 6. Custom Building Products.
 7. Jamo Inc.
 8. Laticrete International, Inc.
 9. MAPEI Corporation.
 10. Southern Grouts & Mortars, Inc.
 11. Summitville Tiles, Inc.
 12. TEC; H. B. Fuller Construction Products Inc.
- C. Polymer Type: Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.

2.7 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. Vapor-Retarder Membrane: Polyethylene sheeting, ASTM D 4397, 4.0 mils thick.
- C. Metal Edge Strips: Angle or L-shaped, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; stainless-steel, ASTM A 666, 300 Series exposed-edge material.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Blanke Corporation.
 - b. Ceramic Tool Company, Inc.
 - c. Schluter Systems L.P.
- D. 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.
- E. Grout Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Bonsal American, an Oldcastle company; Grout Sealer.
 - b. Custom Building Products; Surfaceguard Sealer.
 - c. Jamo Inc.; Surfaceguard Sealer.
 - d. Southern Grouts & Mortars, Inc.; Grout Sealer.
 - e. Summitville Tiles, Inc.; SL-15, Invisible Seal.
 - f. TEC, H. B. Fuller Construction Products Inc.; Grout Guard Plus Penetrating Grout Sealer.
 - 2. Grout sealers shall comply with requirements of FloorScore certification.

2.8 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 thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.

- a. 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. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
 - 2. 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: 1/8 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.
- K. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.
- L. Grout Sealer: Apply grout sealer to grout joints in tile floors according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

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. Use modified dry-set mortar for bonding material unless otherwise directed in manufacturer's written instructions.

3.5 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.

3.6 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.

3.7 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

- A. Interior Floor Installations, Concrete Subfloor:
 - 1. Ceramic Tile Installation: TCNA F113; thinset mortar.
 - a. Thinset Mortar: Latex-portland cement mortar.
 - b. Grout: High-performance unsanded grout.
- B. Interior Wall Installations, Metal Studs:
 - 1. Ceramic Tile Installation: TCNA W243; thinset mortar on gypsum board.
 - a. Thinset Mortar: Latex-portland cement mortar.
 - b. Grout: High-performance unsanded grout.
 - 2. Ceramic Tile Installation: TCNA W244C or TCNA W244F; thinset mortar on cementitious backer units or fiber-cement backer board.
 - a. Thinset Mortar: Latex-portland cement mortar.
 - b. Grout: High-performance unsanded 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. 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.

1.4 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. Ceiling suspension-system members.
 - 2. Structural members to which suspension systems will be attached.
 - 3. Method of attaching hangers to building structure.
 - 4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
 - 5. Size and location of initial access modules for acoustical panels.
 - 6. Items penetrating finished ceiling and ceiling-mounted items including the following:
 - a. Lighting fixtures.
 - b. Diffusers.
 - c. Grilles.
 - d. Speakers.
 - e. Sprinklers.
 - f. Access panels.
 - g. Perimeter moldings.
- B. Qualification Data: For testing agency.
- C. Evaluation Reports: For each acoustical panel ceiling suspension system, from ICC-ES.

1.5 CLOSEOUT SUBMITTALS

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

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Ceiling Units: Full-size panels equal to 2 percent of quantity installed.
 - 2. Hold-Down Clips: Equal to 2 percent of quantity installed.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site 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.

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.
- B. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Armstrong World Industries, Inc.
 - 2. CertainTeed Corporation.
 - 3. Chicago Metallic Corporation.
 - 4. United States Gypsum Company.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Suspended ceilings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. 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: 50 or less.

2.3 ACOUSTICAL PANELS (ACT-1)

- A. 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.
- B. Classification: Provide panels as follows:
 - 1. Type and Form: Type IV, mineral base with painted finish; Form 2, water felted.
 - 2. Pattern: E (lightly textured).
- C. Color: White.
- D. Light Reflectance (LR): Not less than 0.90.
- E. Ceiling Attenuation Class (CAC): Not less than 35.
- F. Noise Reduction Coefficient (NRC): Not less than 0.75.
- G. Edge/Joint Detail: Beveled Tegal.
- H. Thickness: 5/8 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 PANELS (ACT-2)

- A. 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.
- B. Classification: Provide panels as follows:
 - 1. Type and Form: Type IX, mineral base with painted finish; Form 2, water felted.
 - 2. Pattern: G (smooth).
- C. Color: White.
- D. Light Reflectance (LR): Not less than 0.89.
- E. Ceiling Attenuation Class (CAC): Not less than 33.
- F. Noise Reduction Coefficient (NRC): N/A.
- G. Edge/Joint Detail: Square.
- H. Thickness: 5/8 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.

2.5 METAL SUSPENSION SYSTEM

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Armstrong World Industries, Inc.
 - 2. CertainTeed Corporation.
 - 3. Chicago Metallic Corporation.
 - 4. United States Gypsum Company.
- B. 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.
- A. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 coating designation; with prefinished 15/16-inch- wide metal caps on flanges.
 - 1. Structural Classification: Intermediate-duty system.
 - 2. End Condition of Cross Runners: Override (stepped) type.
 - 3. Face Design: Flat, flush.
 - 4. Cap Material: Cold-rolled steel.

2.6 ACCESSORIES

- A. 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.
- B. Wire Hangers, Braces, and Ties: Provide wires as follows:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 2. Size: Wire diameter sufficient for 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 not less than 0.106-inch- diameter wire.
- C. Seismic Clips: Manufacturer's standard seismic clips designed to secure acoustical panels in place during a seismic event.

2.7 METAL EDGE MOLDINGS AND TRIM

- A. 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. Edge moldings shall fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
2. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 1.5 mils. Comply with ASTM C 635/C 635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

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.
- B. Layout openings for penetrations centered on the penetrating items.

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. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 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. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 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. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. 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.
- D. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- E. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.
1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
 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. Install seismic clips in areas indicated; space according to panel manufacturer's written instructions unless otherwise indicated.

3.4 ERECTION TOLERANCES

- A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.
- B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

3.5 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 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. Thermoplastic-rubber base.

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, not less than 12 inches long.
- C. 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.
- D. Product Schedule: For resilient base and accessory products.

1.4 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.

1.5 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F Insert temperature or more than 95 deg F Insert temperature, 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.
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 VINYL BASE - V

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Armstrong World Industries, Inc.
 - 2. Burke Mercer Flooring Products; a division of Burke Industries Inc.
 - 3. Flexco.
 - 4. Johnsonite; a Tarkett company.
 - 5. Roppe Corporation, USA.
 - 6. VPI Corporation.
- B. Product Standard: ASTM F 1861, Type TV (vinyl, thermoplastic).
 - 1. Group: I (solid, homogeneous).
 - 2. Style and Location:
 - a. Style A, Straight: Provide in areas with carpet.
 - b. Style B, Cove: Provide in areas with resilient flooring.
- C. Minimum Thickness: 0.125 inch.
- D. Height: 4 inches.
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Preformed.
- G. Inside Corners: Job formed.
- H. Colors and Patterns: As selected by Architect from full range of standard colors.

2.2 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.
- C. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of flooring, and in maximum available lengths to minimize running joints.

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. Preformed Corners: Install preformed corners before installing straight pieces.
- G. Job-Formed Corners:
 - 1. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Miter corners to minimize open joints.

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.
- 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 Substantial Completion.

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. Vinyl composition floor tile.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
 - 1. Show details of special patterns.
- C. Samples for Verification: Full-size units of each color and pattern of floor tile required.
- D. Product Schedule: For floor tile.

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 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.
 - 1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

1.7 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.

1.8 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 65 deg F or more than 85 deg F, in spaces to receive floor tile 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 85 deg F.
- C. Maintain humidity within range recommended by manufacturer, but not less than 40% or more than 60%, in spaces to receive floor tile.
- D. Close spaces to traffic during floor tile installation.
- E. Close spaces to traffic for 48 hours after floor tile installation.
- F. 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 tile flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- B. FloorScore Compliance: Resilient tile flooring shall comply with requirements of FloorScore certification.

2.2 VINYL COMPOSITION FLOOR TILE -VCT

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. American Biltrite.
 - 2. Armstrong World Industries, Inc.
 - 3. Congoleum Corporation.
 - 4. Johnsonite; a Tarkett company.
- B. Tile Standard: ASTM F1066, Class 1, solid color.
- C. Wearing Surface: Smooth.
- D. Thickness: 0.125 inch.
- E. Size: 12 by 12 inches.

- F. Colors and Patterns: As selected by Architect from manufacturer's standard range.

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 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 limits for VOC content:
 - a. Vinyl Composition Tile Adhesives: 50 g/L or less.
- C. Floor Polish: Provide protective, liquid floor-polish products as recommended by floor tile manufacturer.

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 FOR TILE

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare 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 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.
 - 4. 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 5 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 80 percent relative humidity level.
 - c. Three tests should be conducted for areas up to 1,000 sq. ft. and one additional test should be conducted for each additional 1,000 sq. ft. of flooring.
5. Adhesive Bond Testing: An adhesive bond test should be performed using the actual flooring materials and adhesive to be installed. The test areas should be a minimum of 36" x 36" and remain in place for at least 72 hours and then evaluated for bond strength to the concrete.
- 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 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 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.
- 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. 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

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 exposed 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.
- D. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.
- E. Cover floor tile until Substantial Completion.

END OF SECTION 096519

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.
- B. Related Requirements:
 - 1. Section 096513 "Resilient Base and Accessories" for resilient wall base and accessories installed with 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 installation recommendations for each type of substrate.
- B. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
 - 1. Carpet Tile: Full-size Sample.
 - 2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- long Samples.
- C. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.
- C. 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 Commercial II certification level.
- B. Fire-Test-Response Ratings: Where indicated, provide carpet tile identical to those of assemblies tested for fire response according to NFPA 253 by a qualified testing agency.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104.

1.9 FIELD CONDITIONS

- A. Comply with CRI 104 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 occupancy levels 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.

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, more than 10 percent edge raveling, snags, runs, dimensional stability, excess static discharge, loss of tuft bind strength, loss of face fiber, and delamination.
 - 3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE (CPT-1)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Shaw Contract Group "Technique Tile" #5T022 or comparable product by another manufacturer.

B. Characteristics:

1. Color/Pattern: Birch #22170.
2. Fiber Content: 100 percent nylon 6, 6 - solution dyed.
3. Fiber Type: Eco Solution Q ® Nylon.
4. Pile Characteristic: Multi-level pattern cut-and-loop pile.
5. Average Density: 5581.
6. Pile Thickness: 0.129 inches.
7. Total Thickness: 0.249 inches.
8. Stitches: 13.0 stitches per inch.
9. Gage: 1/10.
10. Tufted Weight: 20.0 oz./sq. yd.
11. Primary Backing/Backcoating: Synthetic.
12. Secondary Backing: EcoWorx®.
13. Size: 24 by 24 inches.
14. Applied Soil-Resistance Treatment: Manufacturer's standard material.
15. Emissions: Provide carpet tile that complies with testing and product requirements of CRI's "Green Label Plus" program.

2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.
 1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

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. Examine carpet tile for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and 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 Section 033000 "Cast-in-Place Concrete" for slabs receiving carpet tile.
3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
- 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. 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 carpet tile manufacturer.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

- A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: Monolithic.
- 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 finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- G. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
 1. Remove excess adhesive, seam sealer, 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 104, Section 16, "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 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 surface preparation and the application of paint systems on interior substrates.
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications" for shop priming metal fabrications and metal pan stairs.
 - 2. Section 133419 "Metal Building Systems" for shop priming structural steel.

1.3 DEFINITIONS

- A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
 - 2. Indicate VOC content.
- B. Samples for Verification: For each type of paint system and in 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.

- C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

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. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

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 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Behr Paint Company; Behr Process Corporation.
 2. Benjamin Moore & Co.
 3. Kelly-Moore Paint Company Inc.
 4. PPG Paints.
 5. Pratt & Lambert.
 6. Rust-Oleum Corporation; a subsidiary of RPM International, Inc.
 7. Sherwin-Williams Company (The).
 8. Valspar Corporation (The).

2.2 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. 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.

C. Colors: As selected by Architect from manufacturer's full range.

2.3 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance 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.

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. Fiber-Cement Board: 12 percent.
 3. Masonry (Clay and CMUs): 12 percent.
 4. Wood: 15 percent.
 5. 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 in "MPI Architectural Painting Specification Manual" 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. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.
- E. 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.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 - 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. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. 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.
- D. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. No not paint work where exposed in equipment rooms.
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 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

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 INTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Traffic Surfaces:
 1. Concrete Stain System MPI INT 3.2E:
 - a. First Coat: Stain, interior, for concrete floors, matching topcoat.
 - b. Topcoat: Stain, interior, for concrete floors, MPI #58.

B. Steel Substrates:

1. High-Performance Architectural Latex System MPI INT 5.1R:
 - a. Prime Coat: Primer, alkyd, quick dry, for metal, MPI #76.
 - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.

C. Gypsum Board Substrates:

1. Institutional Low-Odor/VOC Latex System MPI INT 9.2M:
 - a. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #149.
 - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - c. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2), MPI #144.
2. High-Performance Architectural Latex System MPI INT 9.2B:
 - a. Prime Coat: Primer sealer, latex, interior, MPI #50.
 - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4), MPI #140.

D. Wood Substrates: Wood trim.

1. High-Performance Architectural Latex System MPI INT 6.3A:
 - a. Prime Coat: Primer, latex, for interior wood, MPI #39.
 - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4), MPI #140.

END OF SECTION 099123

SECTION 101100 - VISUAL DISPLAY UNITS

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. Visual display board assemblies.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and accessories for visual display units.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for surface-burning characteristics of tackboards.
- C. Sample Warranties: For special warranties.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver factory-fabricated visual display units completely assembled in one piece. If dimensions exceed maximum manufactured unit size, or if unit size is impracticable to ship in one piece, provide two or more pieces with joints in locations indicated on approved Shop Drawings.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install visual display units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.7 WARRANTY

- A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Surfaces lose original writing and erasing qualities.
 - b. Surfaces exhibit crazing, cracking, or flaking.
2. Warranty Period: 50 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 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: 25 or less.
 2. Smoke-Developed Index: 50 or less.

2.2 VISUAL DISPLAY BOARD ASSEMBLY

- A. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. AARCO Products, Inc.
 2. ADP Lemco, Inc.
 3. Architectural School Products Ltd.
 4. Aristocrat Industries, Inc.
 5. Aywon.
 6. Bangor Cork Company, Inc.
 7. Best-Rite Manufacturing; a brand division of MooreCo, Inc.
 8. Claridge Products and Equipment, Inc.
 9. Egan Visual Inc.
 10. EverWhite; a division of Glenroy, Inc.
 11. Ghent Manufacturing, Inc.
 12. Marsh Industries, Inc.; Visual Products Group.
 13. Newline Products, Inc.
 14. Peter Pepper Products, Inc.
 15. Platinum Visual Systems; a division of ABC School Equipment, Inc.
- B. Visual Display Board Assembly: Factory fabricated.
 1. Assembly: markerboard.
 2. Corners: Square.
 3. Width: 60-inches.
 4. Height: 48-inches.
 5. Mounting Method: Direct to wall.
- C. Markerboard Panel: Porcelain-enamel-faced markerboard panel on core indicated.
 1. Color: White.

- D. Tackboard Panel: Polyester-fabric-faced tackboard panel on core indicated.
 - 1. Fabric Wrapped Edge: Wrap edge of tackboard panel with fabric facing.
 - 2. Color and Pattern: As selected by Architect from standard range of colors.
- E. Aluminum Frames: Fabricated from not less than 0.062-inch-thick, extruded aluminum; standard size and shape.
 - 1. Aluminum Finish: Clear anodic finish.

2.3 MARKERBOARD PANELS

- A. Porcelain-Enamel Markerboard Panels: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction, consisting of moisture-barrier backing, core material, and porcelain-enamel face sheet with high-gloss finish. Laminate panels under heat and pressure with manufacturer's standard, flexible waterproof adhesive.
 - 1. Face Sheet Thickness: 0.021-inch uncoated base metal thickness.
 - 2. Particleboard Core: 3/8-inch-thick; with 0.015-inch-thick, aluminum sheet or 0.013-inch-thick, galvanized-steel sheet backing.
 - 3. Laminating Adhesive: Manufacturer's standard moisture-resistant thermoplastic type.

2.4 TACKBOARD PANELS

- A. Tackboard Panels:
 - 1. Facing: Polyester fabric.
 - 2. Core: 3/8-inch-thick fiberboard.

2.5 MATERIALS

- A. Porcelain-Enamel Face Sheet: PEI-1002, with face sheet manufacturer's standard two- or three-coat process.
- B. Particleboard: ANSI A208.1, Grade M-1, made with binder containing no urea formaldehyde.
- C. Polyester Fabric: Nondirectional weave, 100 percent polyester; weighing not less than 15 oz./sq. yd.; with surface-burning characteristics indicated.
- D. Fiberboard: ASTM C208 cellulosic fiber insulating board.
- E. Extruded Aluminum: ASTM B 221, Alloy 6063.
- F. Adhesives for Field Application: Mildew-resistant, nonstaining adhesive for use with specific type of panels, sheets, or assemblies; and for substrate application; as recommended in writing by visual display unit manufacturer.
 - 1. Adhesives shall have a VOC content of 50 g/L or less.

2.6 GENERAL FINISH REQUIREMENTS

- 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: Noticeable variations in same piece are unacceptable. 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.

2.7 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 and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.
- B. Examine walls and partitions for proper preparation and backing for visual display units.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances, such as dirt, mold, and mildew, that could impair the performance of and affect the smooth, finished surfaces of visual display boards.
- C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display units and wall surfaces.

3.3 INSTALLATION

- A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
- B. Factory-Fabricated Visual Display Board Assemblies: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display board assemblies with fasteners at not more than 16 inches o.c. Secure tops and bottoms of boards to walls.

- C. Visual Display Board Assembly Mounting Heights: Install visual display units at mounting heights indicated on Drawings, or if not indicated, at heights indicated below.

- 1. Mounting Height: 36 inches above finished floor to bottom edge.

3.4 CLEANING AND PROTECTION

- A. Clean visual display units according to manufacturer's written instructions. Attach one removable cleaning instructions label to visual display unit in each room.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.
- C. Cover and protect visual display units after installation and cleaning.

END OF SECTION 101100

SECTION 101423.13 - ROOM-IDENTIFICATION 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 room-identification signs that are directly attached to the building.

1.3 DEFINITIONS

- A. Accessible: In accordance with the accessibility standard.

1.4 COORDINATION

- A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.
- B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For room-identification 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, including raised characters and Braille, and layout for each sign at full scale.
- C. 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. Room-Identification Signs: Full-size Sample.
 - 2. Exposed Accessories: Full-size Sample of each accessory type.
 - 3. Full-size Samples, if approved, will be returned to Contractor for use in Project.
- D. Product Schedule: For room-identification signs. Use same designations indicated on Drawings or specified.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.

- B. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

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

1.8 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. Tools: Two set(s) of specialty tools for assembling signs and replacing variable sign components.

1.9 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.10 FIELD CONDITIONS

- A. Field Measurements: Verify locations of anchorage devices embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.11 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. Deterioration of embedded graphic image.
 - c. Separation or delamination of sheet materials and components.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

2.2 ROOM-IDENTIFICATION SIGNS

- A. Room-Identification Sign: Sign system with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ACE Sign Systems, Inc.
 - b. Advance Corporation.
 - c. Allen Industries Architectural Signage.
 - d. APCO Graphics, Inc.
 - e. ASE, Inc.
 - f. ASI Sign Systems, Inc.
 - g. Best Sign Systems, Inc.
 - h. Clarke Systems.
 - i. Cosco.
 - j. Diskey Architectural Signage Inc.
 - k. InPro Corporation (IPC).
 - l. Mohawk Sign Systems.
 - m. Nelson-Harkins Industries.
 - n. Poblocki Sign Company, LLC.
2. Laminated-Sheet Sign: Sandblasted polymer face sheet with raised graphics laminated over subsurface graphics to acrylic backing sheet to produce composite sheet.
 - a. Composite-Sheet Thickness: Manufacturer's standard for size of sign 0.125 inch.
 - b. Subsurface Graphics: Reverse halftone or dot-screen image.
 - c. Color(s): As selected by Architect from manufacturer's full range.
3. Sign-Panel Perimeter: Finish edges smooth.
 - a. Edge Condition: Square cut.
 - b. Corner Condition in Elevation: Square.
4. Frame: Horizontal retainers.
 - a. Material: Aluminum.
 - b. Frame Depth: Convex-curved frame to receive removable face sheet and changeable subsurface graphics.
 - c. Profile: Square.
 - d. Corner Condition in Elevation: Square.
 - e. Finish and Color: Clear anodized.
5. Mounting: Manufacturer's standard method for substrates indicated with concealed anchors.
6. Text and Typeface: Accessible raised characters and Braille typeface as selected by Architect from manufacturer's full range and variable content as scheduled. Finish raised characters to contrast with background color, and finish Braille to match background color.

2.3 SIGN MATERIALS

- A. Aluminum Sheet and Plate: ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

- B. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- C. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
- D. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure 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.
- B. Adhesive: As recommended by sign manufacturer.

2.5 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
 - 1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
 - 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 - 3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 - 4. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
- B. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.

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.

2.7 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 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. Install signs so they do not protrude or obstruct according to the accessibility standard.
 - 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Accessibility: Install signs in locations on walls as indicated on Drawings and according to the accessibility standard.
- C. 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. 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.
 - 3. 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.
 - 4. 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.
 - 5. Hook-and-Loop Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply sign component of two-part tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage; push to engage tape adhesive. Keep tape strips 0.250 inch away from edges to prevent visibility at sign edges when sign is initially installed or reinstalled. Apply substrate component of tape to substrate in locations aligning with tape on back of sign; push and rub well to fully engage tape adhesive to substrate.
 - 6. Magnetic 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.

3.2 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs 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 101423.13

SECTION 102113.19 - PLASTIC 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-plastic toilet compartments configured as toilet enclosures and urinal screens.

B. Related Requirements:

- 1. Section 012300 "Alternates" for procedures for alternates for Owner Preferred Brands.
- 2. Section 102800 "Toilet, Bath, and Laundry Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories mounted on toilet compartments.

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 toilet compartments.

B. Shop Drawings: For toilet compartments.

- 1. Include plans, elevations, sections, details, and attachment details.
- 2. Show locations of centerlines of toilet fixtures.
- 3. Show locations of floor drains.

C. 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 toilet compartments, prepared on 6-inch-square Samples of same thickness and material indicated for Work.
- 2. Each type of hardware and accessory.

D. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location and selected colors for toilet compartment material.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of toilet compartment.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For toilet compartments 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 and source.
 - 1. Door Hinges: One hinge with associated fasteners.
 - 2. Latch and Keeper: One latch and keeper with associated fasteners.
 - 3. Door Bumper: One bumper with associated fasteners.
 - 4. Door Pull: One door pull with associated fasteners.
 - 5. Fasteners: Ten fasteners of each size and type.

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.

1.8 WARRANTIES

- A. Provide manufacturer's 25-year warranty against breakage, corrosion, and delamination under normal conditions.

PART 2 - PRODUCTS

2.1 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: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for toilet compartments designated as accessible.

2.2 SOLID-PLASTIC TOILET COMPARTMENTS

- A. Manufacturer: Subject to compliance with requirements, provide products manufactured by one of the following:
 - 1. Accurate Partitions Corp.; ASI Group.
 - 2. Ampco Products, LLC.
 - 3. Bradley Corporation.
 - 4. Columbia Lockers; Partition Systems International of South Carolina.
 - 5. General Partitions Mfg. Corp.
 - 6. Global Partitions; ASI Group.

7. Hadrian Manufacturing Inc.
8. Inpro Corporation.
9. Knickerbocker Partition Corporation.
10. Metpar Corp.
11. Scranton Products.

B. Alternative Manufacturers – Owner Preferred Brands (Refer to Section 012300 – Alternates)

1. InPro Endurant® (no substitution)

C. Toilet-Enclosure Style: Overhead braced, floor anchored.

D. Urinal-Screen Style: Wall hung.

E. Door, Panel, Screen, and Pilaster Construction: Solid, high-density polyethylene (HDPE) 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.

F. Pilaster: Manufacturer's standard design; stainless steel.

G. Brackets (Fittings):

1. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.

2.3 HARDWARE AND ACCESSORIES

A. Hardware and Accessories: Manufacturer's standard operating hardware and accessories.

1. Material: Stainless steel.
2. Hinges: Manufacturer's standard continuous.
3. Latch and Keeper: Manufacturer's standard 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. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, 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 compatible with related materials.

2.4 MATERIALS

- A. Aluminum Castings: ASTM B 26/B 26M.
- B. Aluminum Extrusions: ASTM B 221.
- C. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.
- D. Stainless-Steel Castings: ASTM A 743/A 743M.

2.5 FABRICATION

- A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.
- B. 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.
- C. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.
- D. Door Size and Swings: Unless otherwise indicated, provide minimum 32-inch-wide, out-swinging doors for standard toilet compartments and 36-inch-wide, out-swinging doors with a minimum 32-inch-wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.
 - 1. Confirm location and adequacy of blocking and supports required for installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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.

2. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.
 - a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.

- 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.
- C. Floor-Anchored Units: Set pilasters with anchors penetrating not less than 2 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.

3.3 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 102113.19

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. Childcare accessories.
- 3. Underlavatory guards.

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. 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.

1.7 WARRANTY

- A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, visible silver spoilage defects.
 - 2. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 OWNER-FURNISHED MATERIALS

- A. Owner-Furnished Materials: see accessory schedule below.

2.2 MANUFACTURERS

- A. Source Limitations: Obtain washroom accessories from single source from single manufacturer.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. American Specialties, Inc.
 - b. Bobrick Washroom Equipment, Inc.
 - c. Bradley Corporation.
 - d. Tubular Specialties Manufacturing, Inc.

2.3 PUBLIC-USE WASHROOM ACCESSORIES

- A. Waste Receptacle:
 - 1. Freestanding, provided by Owner.
- B. Grab Bar (A):
 - 1. Basis-of-Design Product: Brobrick #B-6806.99 x 18
 - 2. Mounting: Flanges with concealed fasteners.
 - 3. Material: Stainless steel, 0.05 inch thick.
 - 4. Finish: Smooth, No. 4 finish (satin).
 - 5. Outside Diameter: 1-1/2 inches.
 - 6. Configuration and Length: Straight, 18 inches long.
- C. Grab Bar (B):
 - 1. Basis-of-Design Product: Brobrick #B-6806.99 x 36
 - 2. Mounting: Flanges with concealed fasteners.
 - 3. Material: Stainless steel, 0.05 inch thick.
 - 4. Finish: Smooth, No. 4 finish (satin).
 - 5. Outside Diameter: 1-1/2 inches.
 - 6. Configuration and Length: Straight, 36 inches long.

D. Grab Bar (C):

1. Basis-of-Design Product: Brobrick #B-6806.99 x 42
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch thick.
4. Finish: Smooth, No. 4 finish (satin).
5. Outside Diameter: 1-1/2 inches.
6. Configuration and Length: Straight, 42 inches long.

E. Automatic Liquid-Soap Dispenser (E):

1. Description: Automatic dispenser provided by Owner.
2. Mounting: Vertically mounted.

F. Mirror Unit (F):

1. Frame: Stainless-steel channel.
 - a. Corners: Welded and ground smooth.
2. 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.
3. Size: 18 x 36.

G. Automatic Paper Towel (Roll) Dispenser:

1. Description: Automatic provided by Owner.
2. Mounting: Surface mounted.

H. Toilet Tissue (Roll) Dispenser:

1. Description: Dispenser provided by Owner.
2. Mounting: Surface mounted.

I. Coat Hook:

1. Description: Single-prong unit.
2. Material and Finish: Stainless steel, No. 4 finish (satin).

2.4 WARM AIR DRYERS

A. Multiple Airflow Warm-Air Dryer (D):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Specialties, Inc.
 - b. Dyson Inc.

- c. Saniflow Hand Dryer Corporation.
 - d. World Dryer Corporation.
- 2. Description: Multiple airflow warm-air hand dryer, using two or more airstreams for rapid hand drying.
 - 3. Mounting: Surface mounted.
 - 4. Operation: Electronic-sensor activated with operation time of 10 to 20 seconds.
 - 5. Cover Material and Finish: Polycarbonate-ABS casing, white.
 - 6. Electrical Requirements: 115 V, 13 A, 1500 W.

2.5 CHILDCARE ACCESSORIES

A. Source Limitations: Obtain childcare accessories from single source from single manufacturer.

B. Diaper-Changing Station (L):

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. American Specialties, Inc.
 - b. Diaper Deck & Company, Inc.
 - c. Foundations Children's Products.
 - d. GAMCO Specialty Accessories; a division of Bobrick.
 - e. Koala Kare Products.
 - f. SafeStrap Company, Inc. (SSC, Inc.).
 - g. Tubular Specialties Manufacturing, Inc.
- 2. Description: Unit that opens by folding down from stored position and with child-protection strap.
 - a. Engineered to support minimum of 250-lb static load when opened.
- 3. Mounting: Surface mounted, with unit projecting not more than 4 inches from wall when closed.
- 4. Operation: By pneumatic shock-absorbing mechanism.
- 5. Material and Finish: HDPE in manufacturer's standard color.
- 6. Liner Dispenser: Built in.

2.6 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.
- B. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.
- C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch minimum nominal thickness.
- D. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.

- E. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- F. 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.
- G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.7 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 F 446.

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. Portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.
 - 2. Fire protection cabinets for portable fire extinguishers.

1.3 QUALITY ASSURANCE

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
 - 1. Provide fire extinguishers approved, listed, and labeled by FMG.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.
 - 1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
- B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
 - 1. Size: 6 by 6 inches square.
- D. Product Schedule: For fire protection cabinets. Coordinate final fire protection cabinet schedule with fire extinguisher schedule to ensure proper fit and function. Use same designations indicated on Drawings.
- E. 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 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
- B. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:
 - 1. Sheet: ASTM B 209.
 - 2. Extruded Shapes: ASTM B 221.
- C. Stainless-Steel Sheet: ASTM A 666, Type 304.
- D. Transparent Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), 6 mm thick, with Finish 1 (smooth or polished).

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet indicated.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Amerex Corporation.
 - b. Ansul Incorporated; Tyco International Ltd.
 - c. Badger Fire Protection; a Kidde company.
 - d. Buckeye Fire Equipment Company.
 - e. Fire End & Croker Corporation.
 - f. J. L. Industries, Inc.; a division of Activar Construction Products Group.
 - g. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
 - h. Larsen's Manufacturing Company.
 - i. Moon-American.
 - j. Pem All Fire Extinguisher Corp.; a division of PEM Systems, Inc.
 - k. Potter Roemer LLC.
 - l. Pyro-Chem; Tyco Safety Products.
- B. Multipurpose Dry-Chemical Type in Steel Container FE-1 UL-rated 4-A:60-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container. Provide at FE or FEC.

- C. Wet-Chemical Type FE-2: UL-rated 2-A:1-B:C:K, 1.6-gal. nominal capacity, with potassium acetate-based chemical in stainless-steel container, with pressure indicating gage. Provide at FE-K.

2.3 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Amerex Corporation.
 - b. Ansul Incorporated; Tyco International Ltd.
 - c. Badger Fire Protection; a Kidde company.
 - d. Buckeye Fire Equipment Company.
 - e. Fire End & Croker Corporation.
 - f. J. L. Industries, Inc.; a division of Activar Construction Products Group.
 - g. Larsen's Manufacturing Company.
 - h. Potter Roemer LLC.
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.
 - 1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

2.4 FIRE PROTECTION CABINET (FEC)

- A. Cabinet Type: Suitable for fire extinguisher.
 - 1. Basis-of-Design Products: Subject to compliance with requirements, provide J.L. Industries Ambassador Series No. 1017 at semirecessed locations, or a comparable product by one of the following manufacturers:
 - 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
 - e. Modern Metal Products, Division of Technico Inc.
 - f. Moon-American
 - g. Potter Roemer LLC
 - h. Watrous Division, American Specialties, Inc.
- B. Cabinet Construction: Nonrated.
- C. Cabinet Material: Steel sheet.
- D. Semirecessed Cabinet: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping

surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semirecessed cabinet installation.

1. Square-Edge Trim: 1-1/4- to 1-1/2-inch backbend depth.

E. Cabinet Trim Material: Steel sheet.

F. Door Material: Steel sheet.

G. Door Style: V – vertical duo with pull.

H. Door Glazing: Acrylic sheet.

1. Acrylic Sheet Color: Clear transparent acrylic sheet.

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 projecting lever handle with cam-action 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. 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."

2.5 CABINET 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.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.6 GENERAL FINISH REQUIREMENTS

- 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 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.

2.7 STEEL FINISHES

- A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning".
- B. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.
 - 1. Color and Gloss: white, gloss.

PART 3 - EXECUTION

3.1 FIRE EXTINGUISHER EXECUTION

- A. EXAMINATION
 - 1. Examine fire extinguishers for proper charging and tagging.
 - a. Remove and replace damaged, defective, or undercharged fire extinguishers.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. INSTALLATION
 - 1. General: Install fire extinguishers in locations indicated and in compliance with requirements of authorities having jurisdiction.

3.2 CABINET EXECUTION

- A. EXAMINATION
 - 1. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. PREPARATION
 - 1. Prepare recesses for semirecessed fire protection cabinets as required by type and size of cabinet and trim style.

C. INSTALLATION

1. Install fire protection cabinets in locations and at mounting heights acceptable to authorities having jurisdiction.
2. Fasten cabinets to structure, square and plumb.
3. Identification: Apply decals at locations indicated.

D. ADJUSTING AND CLEANING

1. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
2. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
3. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
4. 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.
5. 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 107316 – ALUMINUM CANOPY SYSTEMS

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. Hanger rod supported, pre-engineered metal canopies including fascia channels, decking, tension rods, and attachment hardware.

1.3 ACTION SUBMITTALS

- A. Verification Samples:

- 1. For each finish product specified, two samples, minimum size 3 inches square, representing actual product, color, and patterns.

- B. Shop Drawings:

- 1. Include plans, elevations, sections, mounting heights, and attachment details.
 - 2. Detail fabrication and assembly of canopies.
 - 3. Show locations for blocking, reinforcement, and supplementary structural support.

1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that 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.

- B. Welder Qualifications: All welders must be AWS certified welders.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the requirements, provide products from one of the following manufacturers:

- 1. C. R. Laurence Co.
 - 2. Lawrence Fabric & Metal Structures
 - 3. MASA Architectural Canopies
 - 4. Tajima Corporation USA

2.2 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- B. Design members to withstand dead, live, wind and other applicable loads in accordance with ASCE-7 and applicable codes.

2.3 EXTERIOR CANOPY SYSTEM

- A. Hanger Rod Supported Metal Canopies: Building supported, pre-engineered metal canopy system provided with fascia channels, decking, tension rods, and attachment hardware.
 - 1. Materials:
 - a. Aluminum Extrusions: ASTM B 221 and ASTM B 429 6061-T6 alloy and temper.
 - b. Fasteners: Stainless steel or hot dip galvanized for corrosion resistance.
 - 2. Fascia:
 - a. Standard 8 Inch.
 - 3. Decking Profiles:
 - a. Flat Soffit Decking
 - 4. Wall Plate Designs:
 - a. 3-inch diameter standard.
 - 5. Framing:
 - a. Type: Extruded aluminum J channels.
 - b. Size: 8 inch by 1/8 inch thick.
 - 6. Canopy Supports:
 - a. 3 inch by 2.5 inch by .25-inch Extruded Aluminum Canopy Support "I" Beam.
 - b. Attachment: 1-inch diameter steel hanger rod finished to match canopy
 - 7. Accessories:
 - a. Anchors and Fasteners: Stainless steel or hot dip galvanized and corrosion resistant.
 - 8. Finish:
 - a. Powdercoat: AAMA 2603 Thermosetting Polyester Resin-based Powder. Color as selected by the Architect from manufacturer's standard range.

- B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187.
- 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.

2.4 FABRICATION

- A. Fabricate system in accordance with approved Shop Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. Field verifies dimensions of supporting structure and any openings at site of installation prior to fabrication
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install components plumb and level, in proper plane, free from warp and twist.
- C. Anchor system to building components; provide adequate clearance for movement caused by thermal expansion and contraction and wind loads.

3.4 CLEANING

- A. Clean all surfaces and restore any marred or abraded surfaces to original conditions as approved by the Architect.

3.5 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 017300

SECTION 123661.16 - SOLID SURFACING 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.
2. Solid surface material end and backsplashes.
3. Solid surface material apron fronts.

B. Related Requirements:

1. Section 064116 "Plastic Laminate Faced Architectural Cabinets".

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.

1. Show locations and details of joints.
2. Show direction of directional pattern, if any.

C. Samples for Verification: For the following products:

1. Countertop material, 6 inches square.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For solid surface material countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.

- B. Installer Qualifications: Fabricator of countertops.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of countertops by field measurements before countertop fabrication is complete.

1.8 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 SOLID SURFACE COUNTERTOP MATERIALS

- A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Affinity Surfaces; a brand of Domain Industries, Inc.
 - b. Avonite Surfaces; a brand of Aristech Surface, LLC.
 - c. E. I. du Pont de Nemours and Company.
 - d. Formica Corporation.
 - e. LG Hausys America, Inc.
 - f. Meganite Inc.
 - g. Samsung Chemical USA, Inc.
 - h. Wilsonart.
 - 2. Integral Sink Bowls: Comply with CSA B45.5/IAPMO Z124.
 - 3. Colors and Patterns: As selected by Architect from manufacturer's full range.
- B. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.2 COUNTERTOP FABRICATION

- A. Configuration:
 - 1. As detailed.
- B. Countertops: 1/2-inch- thick, solid surface material with front edge built up with same material.
- C. Backsplashes: 1/2-inch- thick, solid surface material.
- D. Fabricate tops with shop-applied edges and backsplashes unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
- E. Joints: Fabricate countertops without joints.

F. Cutouts and Holes:

1. Fittings: Drill countertops in shop for plumbing fittings, and similar items.

2.3 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by solid surface material manufacturer.
- B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to receive solid surface material countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.
- B. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
- C. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions. 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.
- D. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.
- E. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Predrill holes for screws as recommended by manufacturer.
- F. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
- G. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION 123661.16

SECTION 133419 - METAL BUILDING SYSTEMS

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 framing.
- 2. Metal roof panels.
- 3. Metal soffit panels.
- 4. Thermal insulation.
- 5. Accessories.

B. Related Requirements:

- 1. Section 074213.13 "Formed Metal Wall Panels" for exterior wall panels.
- 2. Section 083613 "Sectional Doors" for sectional vehicular doors in metal building systems.

1.3 DEFINITIONS

- A. Terminology Standard: See MBMA's "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in standards referenced by this Section.

1.4 COORDINATION

- A. Coordinate sizes and locations of concrete foundations and casting of anchor-rod inserts into foundation walls and footings. Anchor rod installation, concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete."
- B. Coordinate metal panel assemblies with rain drainage work, flashing, trim, and construction of supports and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

- 1. Review methods and procedures related to metal building systems including, but not limited to, the following:
 - a. Condition of foundations and other preparatory work performed by other trades.
 - b. Structural load limitations.

- c. Construction schedule. Verify availability of materials and erector's personnel, equipment, and facilities needed to make progress and avoid delays.
 - d. Required tests, inspections, and certifications.
 - e. Unfavorable weather and forecasted weather conditions and impact on construction schedule.
- 2. Review methods and procedures related to metal roof panel assemblies including, but not limited to, the following:
 - a. Compliance with requirements for purlin and rafter conditions, including flatness and attachment to structural members.
 - b. Structural limitations of purlins and rafters during and after roofing.
 - c. Flashings, special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect metal roof panels.
 - d. Temporary protection requirements for metal roof panel assembly during and after installation.
 - e. Roof observation and repair after metal roof panel installation.
- 3. Review methods and procedures related to metal wall panel assemblies including, but not limited to, the following:
 - a. Compliance with requirements for support conditions, including alignment between and attachment to structural members.
 - b. Structural limitations of girts and columns during and after wall panel installation.
 - c. Flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.
 - d. Temporary protection requirements for metal wall panel assembly during and after installation.
 - e. Wall observation and repair after metal wall panel installation.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of metal building system component.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Metal roof panels.
 - b. Metal wall panels.
 - c. Thermal insulation and vapor-retarder facings.
- B. Shop Drawings: Indicate components by others. Include full building plan, elevations, sections, details and the following:
 - 1. Anchor-Rod Plans: Submit anchor-rod plans and templates before foundation work begins. Include location, diameter, and minimum required projection of anchor rods required to attach metal building to foundation. Indicate column reactions at each location.
 - 2. Structural-Framing Drawings: Show complete fabrication of primary and secondary framing; include provisions for openings. Indicate welds and bolted connections, distinguishing between shop and field applications. Include transverse cross-sections.

- a. Show provisions for attaching pipe racks.
 - 3. Metal Roof and Wall Panel Layout Drawings: Show layouts of panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, clip spacing, trim, flashings, closures, and special details. Distinguish between factory- and field-assembled work; show locations of exposed fasteners.
 - a. Show roof-mounted items including roof hatches, equipment supports, pipe supports and penetrations, lighting fixtures, and items mounted on roof curbs.
 - b. Show wall-mounted items including personnel doors, vehicular doors, windows, louvers, and lighting fixtures.
 - c. Show translucent panels.
 - 4. Accessory Drawings: 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 Verification: For the following products:
 - 1. Panels: Nominal 12 inches long by actual panel width. Include fasteners, closures, and other exposed panel accessories.
 - D. Delegated-Design Submittal: For metal building systems.
 - 1. Include analysis data indicating compliance with performance requirements and design data signed and sealed by the qualified professional engineer responsible for their preparation.
- 1.7 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For manufacturer.
 - B. Welding certificates.
 - C. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:
 - 1. Name and location of Project.
 - 2. Order number.
 - 3. Name of manufacturer.
 - 4. Name of Contractor.
 - 5. Building dimensions including width, length, height, and roof slope.
 - 6. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
 - 7. Governing building code and year of edition.
 - 8. Design Loads: Include dead load, roof live load, collateral loads, roof snow load, deflection, wind loads/speeds and exposure, seismic design category or effective peak velocity-related acceleration/peak acceleration, and auxiliary loads (cranes).

9. Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.
 10. Building-Use Category: Indicate category of building use and its effect on load importance factors.
- D. Erector Certificates: For qualified erector, from manufacturer.
- E. Material Test Reports: For each of the following products:
1. Structural steel including chemical and physical properties.
 2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 3. Tension-control, high-strength, bolt-nut-washer assemblies.
 4. Shop primers.
 5. Nonshrink grout.
- F. Source quality-control reports.
- G. Field quality-control reports.
- H. Surveys: Show final elevations and locations of major members. Indicate discrepancies between actual installation and the Contract Documents. Have surveyor who performed surveys certify their accuracy.
- I. Sample Warranties: For special warranties.
- 1.8 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For metal panel finishes to include in maintenance manuals.
- 1.9 QUALITY ASSURANCE
- A. Manufacturer Qualifications: A qualified manufacturer.
1. Accreditation: Manufacturer's facility accredited according to the International Accreditation Service's AC472, "Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems."
 2. Engineering Responsibility: Preparation of comprehensive engineering analysis and Shop Drawings by a professional engineer who is legally qualified to practice in jurisdiction where Project is located.
- B. Erector Qualifications: An experienced erector who specializes in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 2. AWS D1.3, "Structural Welding Code - Sheet Steel."
- D. Land Surveyor Qualifications: A professional land surveyor who practices in jurisdiction where Project is located and who is experienced in providing surveying services of the kind indicated.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, 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.

1.11 FIELD CONDITIONS

- A. Weather Limitations: Proceed with panel installation only when weather conditions permit metal panels to be installed according to manufacturers' written instructions and warranty requirements.

1.12 WARRANTY

- A. Special Warranty on Metal Panel Finishes: 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 D2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.
- B. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that leak or otherwise fail to remain weathertight within specified warranty period.
 - 1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain metal building system components, including primary and secondary framing and metal panel assemblies, from single source from single manufacturer.

2.2 SYSTEM DESCRIPTION

- A. Provide a complete, integrated set of mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced

movement, and exposure to weather without failure or infiltration of water into building interior.

B. Primary-Frame Type:

1. Rigid Modular: Solid-member, structural-framing system with interior columns.

C. End-Wall Framing: Manufacturer's standard, for buildings not required to be expandable, consisting of primary frame, capable of supporting one-half of a bay design load, and end-wall columns.

D. Secondary-Frame Type: Manufacturer's standard purlins and joists and flush-framed girts.

E. Eave Height: Manufacturer's standard height, as indicated by nominal height on Drawings.

F. Bay Spacing: As indicated on Drawings.

G. Roof Slope: As indicated on Drawings.

H. Roof System: Manufacturer's standard standing-seam metal roof panels.

I. Exterior Wall System: Section 074213.13 "Formed Metal Wall Panels"

2.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design metal building system.

B. Structural Performance: Metal building systems shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to procedures in MBMA's "Metal Building Systems Manual."

1. Design Loads: As indicated on Drawings.
2. Deflection and Drift Limits: Design metal building system assemblies to withstand serviceability design loads without exceeding deflections and drift limits recommended in AISC Steel Design Guide No. 3 "Serviceability Design Considerations for Steel Buildings."
3. Deflection and Drift Limits: No greater than the following:
 - a. Purlins and Rafters: Vertical deflection of 1/240 of the span.
 - b. Girts: Horizontal deflection of 1/120 of the span.
 - c. Metal Roof Panels: Vertical deflection of 1/240 of the span.
 - d. Design secondary-framing system to accommodate deflection of primary framing and construction tolerances, and to maintain clearances at openings.
 - e. Lateral Drift: Maximum of 1/60 of the building height.

C. Seismic Performance: Metal building system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

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: 120 deg F, ambient; 180 deg F, material surfaces.

- E. Structural Performance for Metal Roof Panels: 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.

- F. Air Infiltration for Metal Roof Panels: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E1680 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft.

- G. Water Penetration for Metal Roof Panels: No water penetration when tested according to ASTM E1646 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft.

- H. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.

1. Uplift Rating: UL 90.

- I. Energy Star Listing: Roof panels that are listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.

- J. Thermal Performance for Opaque Elements: Provide the following maximum U-factors and minimum R-values when tested according to ASTM C1363 or ASTM C518:

1. Roof:
 - a. R-Value: R-10 + R-19FC

2.4 STRUCTURAL-STEEL FRAMING

- A. Structural Steel: Comply with AISC 360, "Specification for Structural Steel Buildings."

- B. Bolted Connections: Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts."

- C. Cold-Formed Steel: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" for design requirements and allowable stresses.

- D. Primary Framing: Manufacturer's standard primary-framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse and lean-to frames; rafters, rake, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing.

1. General: Provide frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly. Provide frame span and spacing indicated.

2. Rigid Modular Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Provide interior columns fabricated from round steel pipes or tubes, or shop-welded, built-up steel plates.
 3. Frame Configuration: One-directional, sloped.
 4. Exterior Column: Tapered.
 5. Rafter: Tapered.
- E. End-Wall Framing: Manufacturer's standard primary end-wall framing fabricated for field-bolted assembly to comply with the following:
1. End-Wall and Corner Columns: I-shaped sections fabricated from structural-steel shapes; shop-welded, built-up steel plates; or C-shaped, cold-formed, structural-steel sheet.
- F. Secondary Framing: Manufacturer's standard secondary framing, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Unless otherwise indicated, fabricate framing from either cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet, prepainted with coil coating, to comply with the following:
1. Purlins: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; minimum 2-1/2-inch-wide flanges.
 - a. Depth: As required to comply with system performance requirements.
 2. Purlins: Steel joists of depths indicated on Drawings.
 3. Girts: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes. Form ends of Z-sections with stiffening lips angled 40 to 50 degrees from flange, with minimum 2-1/2-inch-wide flanges.
 - a. Depth: As indicated on Drawings.
 4. Eave Struts: Unequal-flange, C-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; to provide adequate backup for metal panels.
 5. Flange Bracing: Minimum 2-by-2-by-1/8-inch structural-steel angles or 1-inch-diameter, cold-formed structural tubing to stiffen primary-frame flanges.
 6. Sag Bracing: Minimum 1-by-1-by-1/8-inch structural-steel angles.
 7. Base or Sill Angles: Manufacturer's standard base angle, minimum 3-by-2-inch, fabricated from zinc-coated (galvanized) steel sheet.
 8. Purlin and Girt Clips: Manufacturer's standard clips fabricated from steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.
 9. Framing for Openings: Channel shapes; fabricated from cold-formed, structural-steel sheet or structural-steel shapes. Frame head and jamb of door openings and head, jamb, and sill of other openings.
 10. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.
- G. Bracing: Provide adjustable wind bracing using any method as follows:

1. Rods: ASTM A36/A36M; ASTM A572/A572M, Grade 50; or ASTM A529/A529M, Grade 50; minimum 1/2-inch-diameter steel; threaded full length or threaded a minimum of 6 inches at each end.
 2. Cable: ASTM A475, minimum 1/4-inch-diameter, extra-high-strength grade, Class B, zinc-coated, seven-strand steel; with threaded end anchors.
 3. Angles: Fabricated from structural-steel shapes to match primary framing, of size required to withstand design loads.
 4. Rigid Portal Frames: Fabricated from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.
 5. Fixed-Base Columns: Fabricated from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.
 6. Diaphragm Action of Metal Panels: Design metal building to resist wind forces through diaphragm action of metal panels.
- H. Anchor Rods: Headed anchor rods as indicated in Anchor Rod Plan for attachment of metal building to foundation.
- I. Materials:
1. W-Shapes: ASTM A992/A992M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
 2. Channels, Angles, M-Shapes, and S-Shapes: ASTM A36/A36M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
 3. Plate and Bar: ASTM A36/A36M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
 4. Steel Pipe: ASTM A53/A53M, Type E or S, Grade B.
 5. Cold-Formed Hollow Structural Sections: ASTM A500, Grade B or C, structural tubing.
 6. Structural-Steel Sheet: Hot-rolled, ASTM A1011/A1011M, Structural Steel (SS), Grades 30 through 55, or High-Strength Low-Alloy Steel (HSLAS) or High-Strength Low-Alloy Steel with Improved Formability (HSLAS-F), Grades 45 through 70; or cold-rolled, ASTM A1008/A1008M, Structural Steel (SS), Grades 25 through 80, or HSLAS, Grades 45 through 70.
 7. Metallic-Coated Steel Sheet: ASTM A653/A653M, SS, Grades 33 through 80, or HSLAS or HSLAS-F, Grades 50 through 80; with G60 coating designation; mill phosphatized.
 8. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A755/A755M.
 - a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, SS, Grades 33 through 80, or HSLAS or HSLAS-F, Grades 50 through 80; with G90 coating designation.
 - b. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792/A792M, SS, Grade 50 or 80; with Class AZ50 coating.
 9. Non-High-Strength Bolts, Nuts, and Washers: ASTM A307, Grade A, carbon-steel, hex-head bolts; ASTM A563 carbon-steel hex nuts; and ASTM F844 plain (flat) steel washers.
 - a. Finish: Hot-dip zinc coating, ASTM F2329, Class C.

10. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
 - a. Finish: Hot-dip zinc coating, ASTM F2329, Class C.
11. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A490, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
12. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, heavy-hex head assemblies consisting of steel structural bolts with splined ends; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1 hardened carbon-steel washers.
 - a. Finish: Mechanically deposited zinc coating, ASTM B695, Class 50.
13. Unheaded Anchor Rods: ASTM F1554, Grade 36.
 - a. Configuration: Straight.
 - b. Nuts: ASTM A563 heavy-hex carbon steel.
 - c. Plate Washers: ASTM A36/A36M carbon steel.
 - d. Washers: ASTM F436 hardened carbon steel.
 - e. Finish: Hot-dip zinc coating, ASTM F2329, Class C.
14. Headed Anchor Rods: ASTM F1554, Grade 36.
 - a. Configuration: Straight.
 - b. Nuts: ASTM A563 heavy-hex carbon steel.
 - c. Plate Washers: ASTM A36/A36M carbon steel.
 - d. Washers: ASTM F436 hardened carbon steel.
 - e. Finish: Hot-dip zinc coating, ASTM F2329, Class C.
15. Threaded Rods: ASTM A36/A36M.
 - a. Nuts: ASTM A563 heavy-hex carbon steel.
 - b. Washers: ASTM A36/A36M carbon steel.
 - c. Finish: Hot-dip zinc coating, ASTM F2329, Class C.
- J. Finish: Factory primed. Apply specified primer immediately after cleaning and pretreating.
 1. Clean and prepare in accordance with SSPC-SP2.
 2. Coat with manufacturer's standard primer. Apply primer to primary and secondary framing to a minimum dry film thickness of 1 mil.
 - a. Prime secondary framing formed from uncoated steel sheet to a minimum dry film thickness of 0.5 mil on each side.

2.5 METAL ROOF PANELS

- A. Standing-Seam, Vertical-Rib, 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.
 - 1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
 - a. Exterior Finish: Two-coat fluoropolymer.
 - b. Color: As selected by Architect from manufacturer's full range.
 - 2. Clips: Two-piece floating to accommodate thermal movement.
 - 3. Joint Type: Mechanically seamed.
 - 4. Panel Coverage: 16 inches.
 - 5. Panel Height: 2 inches.
- B. Finishes:
 - 1. Exposed Coil-Coated Finish:
 - a. 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.

2.6 METAL SOFFIT PANELS

- A. General: Provide factory-formed 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 and factory-applied sealant 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.
- C. Concealed-Fastener, Flush-Profile, Metal Soffit Panels: Formed with vertical panel edges and flush surface; with flush joint between panels; with 1-inch-wide flange for attaching interior finish; designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps.

1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
2. Panel Coverage: 16 inches.
3. Panel Height: 1 inch.

2.7 THERMAL INSULATION

- A. Mineral-Fiber-Blanket Insulation: ASTM C665, type indicated below; consisting of fibers manufactured from glass, slag wool, or rock wool.
 1. Unfaced: Type I (blankets without membrane covering), passing ASTM E136 for combustion characteristics.
- B. Vapor-Retarder Facing: ASTM C1136, with permeance not greater than 0.02 perm when tested according to ASTM E96/E96M, Desiccant Method.
 1. Composition: White polypropylene film facing and fiberglass-polyester-blend fabric backing.
- C. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

2.8 PERSONNEL DOORS AND FRAMES

- A. Swinging Personnel Doors and Frames: As specified in Section 081113 "Hollow Metal Doors and Frames."

2.9 WINDOWS

- A. Aluminum Openings: As specified in Section 084113 "Aluminum Entrances and Storefronts."

2.10 ACCESSORIES

- A. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.
 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.
- B. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including copings, fasciae, corner units, ridge closures, clips, 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 material as metal roof panels.

2. Clips: Manufacturer's standard, formed from steel sheet, designed to withstand negative-load requirements.
 3. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 4. 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 pre-molded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
 5. Thermal Spacer Blocks: Where metal panels attach directly to purlins, provide thermal spacer blocks of thickness required to provide 1-inch standoff; fabricated from extruded polystyrene.
- C. Flashing and Trim: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, pre-painted with coil coating; finished to match adjacent metal panels.
1. 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.
- D. Gutters: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, pre-painted with coil coating; finished to match roof fascia and rake trim. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch-long sections, sized according to SMACNA's "Architectural Sheet Metal Manual."
1. Gutter Supports: Fabricated from same material and finish as gutters.
 2. Strainers: Bronze, copper, or aluminum wire ball type at outlets.
- E. Downspouts: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, pre-painted with coil coating; finished to match metal wall panels. Fabricate in minimum 10-foot-long sections, complete with formed elbows and offsets.
1. Mounting Straps: Fabricated from same material and finish as gutters.
- F. Materials:
1. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide fasteners with heads matching color of materials being fastened by means of plastic caps or factory-applied coating.
 - a. Fasteners for Metal Roof Panels: Self-drilling, Type 410 stainless steel or self-tapping, Type 304 stainless-steel or zinc-alloy-steel hex washer head, with EPDM washer under heads of fasteners bearing on weather side of metal panels.
 2. 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.

3. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time.
4. Metal Panel Sealants:
 - a. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene-compound sealant tape with release-paper backing. Provide permanently elastic, non-sag, nontoxic, non-staining tape of manufacturer's standard size.
 - b. Joint Sealant: ASTM C920; one-part elastomeric polyurethane or polysulfide; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended by metal building system manufacturer.

2.11 FABRICATION

- A. General: Design components and field connections required for erection to permit easy assembly.
 1. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
 2. Fabricate structural framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Members shall be free of cracks, tears, and ruptures.
- B. Tolerances: Comply with MBMA's "Metal Building Systems Manual" for fabrication and erection tolerances.
- C. Primary Framing: Shop fabricate framing components to indicated size and section, with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.
 1. Make shop connections by welding or by using high-strength bolts.
 2. Join flanges to webs of built-up members by a continuous, submerged arc-welding process.
 3. Brace compression flange of primary framing with steel angles or cold-formed structural tubing between frame web and purlin web or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
 4. Weld clips to frames for attaching secondary framing if applicable, or punch for bolts.
 5. Shop Priming: Prepare surfaces for shop priming according to SSPC-SP 2. Shop prime primary framing with specified primer after fabrication.
- D. Secondary Framing: Shop fabricate framing components to indicated size and section by roll forming or break forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.
 1. Make shop connections by welding or by using non-high-strength bolts.
 2. Shop Priming: Prepare uncoated surfaces for shop priming according to SSPC-SP 2. Shop prime uncoated secondary framing with specified primer after fabrication.

2.12 SOURCE QUALITY CONTROL

- A. Special Inspection: Owner will engage a qualified special inspector to perform source quality control inspections and to submit reports.
 - 1. Accredited Manufacturers: Special inspections will not be required if fabrication is performed by an IAS AC472-accredited manufacturer approved by authorities having jurisdiction to perform such Work without special inspection.
 - a. After fabrication, submit copy of certificate of compliance to authorities having jurisdiction, certifying that Work was performed according to Contract requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with erector present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Before erection proceeds, survey elevations and locations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments to receive structural framing, with erector present, for compliance with requirements and metal building system manufacturer's tolerances.
 - 1. Engage land surveyor to perform surveying.
- C. Proceed with erection only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.
- B. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION OF STRUCTURAL FRAMING

- A. Erect metal building system according to manufacturer's written instructions and drawings.
- B. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.
- C. Set structural framing accurately in locations and to elevations indicated, according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.
- D. Base and Bearing Plates: 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. 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.
 3. 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.
- E. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. 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 will be completed and in service.
- F. Primary Framing and End Walls: Erect framing level, plumb, rigid, secure, and true to line. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist-cure grout for not less than seven days after placement.
1. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt type and joint type specified.
 - a. Joint Type: Snug tightened or pretensioned as required by manufacturer.
- G. Secondary Framing: Erect framing level, plumb, rigid, secure, and true to line. Field bolt secondary framing to clips attached to primary framing.
1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.
 2. Locate and space wall girts to suit openings such as doors and windows.
 3. Provide supplemental framing at entire perimeter of openings, including doors, windows, louvers, ventilators, and other penetrations of roof and walls.
- H. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.
1. Tighten rod and cable bracing to avoid sag.
 2. Locate interior end-bay bracing only where indicated.
- I. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.
- J. Erection Tolerances: Maintain erection tolerances of structural framing within AISC 303.
- 3.4 METAL ROOF PANEL INSTALLATION
- A. General: Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.

1. Install ridge caps as metal roof panel work proceeds.
 2. Flash and seal metal roof panels with weather closures at eaves and rakes. Fasten with self-tapping screws.
- B. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint, at location and spacing and with fasteners recommended by manufacturer.
1. Install clips to supports with self-drilling or self-tapping fasteners.
 2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
 3. Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so that clip, metal roof panel, and factory-applied sealant are completely engaged.
 4. Rigidly fasten eave end of metal roof panels and allow ridge end free movement for thermal expansion and contraction. Predrill panels for fasteners.
 5. Provide metal closures at each side of ridge caps.
- C. Metal Fascia Panels: Align bottom of metal panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws. Flash and seal metal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.

3.5 METAL SOFFIT PANEL INSTALLATION

- A. Provide metal soffit panels the full width of soffits. Install panels perpendicular to support framing.
- B. Flash and seal metal soffit panels with weather closures where panels meet walls and at perimeter of all openings.

3.6 THERMAL INSULATION INSTALLATION

- A. General: Install insulation concurrently with metal panel installation, in thickness indicated to cover entire surface, according to manufacturer's written instructions.
1. Set vapor-retarder-faced units with vapor retarder toward warm side of construction unless otherwise indicated. Do not obstruct ventilation spaces except for firestopping.
 2. Tape joints and ruptures in vapor retarder and seal each continuous area of insulation to the surrounding construction to ensure airtight installation.
 3. Install factory-laminated, vapor-retarder-faced blankets straight and true in one-piece lengths, with both sets of facing tabs sealed, to provide a complete vapor retarder.
- B. Blanket Roof Insulation: Comply with the following installation method:
1. Over-Framing Installation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Hold in place by metal roof panels fastened to secondary framing.
 2. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.

- C. Blanket Wall Insulation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Hold in place by metal wall panels fastened to secondary framing.
 - 1. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.
 - 2. Sound-Absorption Insulation: Where sound-absorption requirement is indicated for metal liner panels, cover insulation with polyethylene film and provide inserts of wire mesh to form acoustical spacer grid.

3.7 DOOR AND FRAME INSTALLATION

- A. General: Install doors and frames plumb, rigid, properly aligned, and securely fastened in place according to manufacturers' written instructions. Coordinate installation with wall flashings and other components. Seal perimeter of each door frame with elastomeric sealant used for metal wall panels.
- B. Personnel Doors and Frames: Install doors and frames according to NAAMM-HMMA 840. Fit non-fire-rated doors accurately in their respective frames, with the following clearances:
 - 1. Between Doors and Frames at Jambs and Head: 1/8 inch.
 - 2. Between Edges of Pairs of Doors: 1/8 inch.
 - 3. At Door Sills with Threshold: 3/8 inch.
 - 4. At Door Sills without Threshold: 3/4 inch.

3.8 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.
 - 2. Install components for a complete metal wall panel assembly, including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 - 3. Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.
- 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. 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 or bayonet-type 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 as required for gutter size, but 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 1-1/2-inch 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.
- E. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.

3.9 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform field quality control special inspections and to submit reports.
- B. Product will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.10 CLEANING AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.
- B. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- C. Touchup Painting: After erection, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted structural framing, bearing plates, and accessories.
 - 1. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or by SSPC-SP 3, "Power Tool Cleaning."
 - 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

END OF SECTION 133419

SECTION 144200 - WHEELCHAIR LIFTS

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. Vertical platform lifts.

- B. Related Requirements:

- 1. Section 099123 "Interior Painting" for field painting of lift equipment.

1.3 DEFINITIONS

- A. Definitions in ASME A18.1 apply to Work of this Section.

1.4 ACTION SUBMITTALS

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

- 1. Include construction details, material descriptions, dimensions of individual components, and finishes for lifts.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, safety features, controls, finishes, and accessories.

- B. Shop Drawings: For each lift.

- 1. Include plans, elevations, sections, attachment details, and required clearances.
 - 2. Indicate dimensions, weights, loads, and points of load to building structure.
 - 3. Include details of equipment assemblies, method of field assembly, components, and location and size of each field connection.
 - 4. Include diagrams for power, signal, and control wiring.

- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of sizes indicated below:

- 1. Metal Finish: Manufacturer's standard-size unit, not less than 3 inches square.
 - 2. Tubular Products and Running Trim: Manufacturer's standard-size unit, 6 inches long.
 - 3. Glass and Glazing: Units 12 inches square.
 - 4. Hardware: Manufacturer's standard, exposed, door-operating device.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and Installer.
- B. Product Certificates: For each type of lift.
 - 1. Include statement that runway, ramp or pit, dimensions as shown on Drawings, and electrical service as shown and specified are adequate for lift being provided.
- C. Evaluation Reports: For post-installed anchors and power-actuated fasteners, from ICC-ES.
- D. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of lift to include in operation and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Parts list with sources indicated.
 - b. Recommended parts inventory list.
- B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted use of lifts.
- C. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard five-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
 - 1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of lifts that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.
- B. Regulatory Requirements: Comply with ASME A18.1, "Safety Standard for Platform Lifts and Stairway Chairlifts."

2.2 VERTICAL PLATFORM LIFT: See sheet A402.

- A. Vertical Platform Lift, General: Pre-engineered lift system.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AmeriGlide.
 - 2. Ascension, Division of AGM Container Controls, Inc.
 - 3. Bruno Independent Living Aids, Inc.
 - 4. Butler Mobility Products.
 - 5. Florlift of New Jersey, Inc.
 - 6. Garaventa Lift.
 - 7. Inclinator Company of America, Inc.
 - 8. Liftavator, Inc.
 - 9. Lift-U.
 - 10. Savaria.
- C. Number of Stops: Two.
- D. Platform Size: 36 by 54 inches.
- E. Door Operation and Clear Opening Width: Low-energy, power-operated doors that remain open for 20 seconds minimum; end door with minimum 32-inch clear opening width.
- F. Rated Speed: 10 fpm.
- G. Power Supply: Electric.
 - 1. Electrical Characteristics:
 - a. Horsepower: 1/3.
 - b. Voltage: 115-V AC, single phase, 60 Hz.
- H. Emergency Operation: Provide manual operation to raise or lower unit to a landing in case of malfunction or power loss.
- I. Self-Supporting Unit: Support vertical loads of unit only at base, with lateral support only at landing levels.
- J. Platform: Steel sheet or galvanized-steel sheet with manufacturer's standard non-slip flooring.
- K. Platform Enclosure and Door: Rectangular steel-tube frame with flush steel-sheet panels.

- L. Ramp: Fixed ramp matching platform to provide transition from floor to lift platform at bottom landing.

- 1. Ramp Size: End ramps a minimum of 32 inches wide; length as required for slope.
 - 2. Ramp Slope: Maximum 1:12.
 - 3. Ramp Finish: Finish ramps to match lift platform.

2.3 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- B. Steel Tubing: ASTM A500/A500M.
- C. Steel Pipe: ASTM A53/A53M; standard weight (Schedule 40) unless otherwise indicated or required by loads.
- D. Steel Sheet: ASTM A1008/A1008M, cold-rolled commercial steel (CS) or ASTM A1011/A1011M hot-rolled, commercial steel (CS); as required for each use.
- E. Galvanized-Steel Sheet: ASTM A653/A653M, G90 zinc coating.
- F. Galvanizing: Hot-dip galvanize items complying with the following:
 - 1. ASTM A123/A123M, for galvanizing steel and iron products.
 - 2. ASTM A153/A153M, for galvanizing steel and iron hardware.
- G. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use, corrosion resistance, and finish indicated; manufacturer's standard strengths and thicknesses for type of use.
 - 1. Extruded Aluminum: ASTM B221.
 - 2. Aluminum Sheet and Plate: ASTM B209.
- H. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing structural members, guide rails, machines, and other lift components where installation of devices is specified in another Section.
- I. Non-shrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.4 FASTENERS

- A. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES standards as appropriate for the substrate.
 - 1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.
- B. Power-Actuated Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

2.5 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.

2.6 FINISHES

- A. Steel Factory Finish:
 - 1. Baked-Enamel or Powder-Coat Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat with a minimum dry film thickness of 1 mil for topcoat.
 - 2. Color and Gloss: As selected by Architect from manufacturer's standard range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, critical dimensions, and other conditions affecting performance of the Work.
- B. Minimum Headroom Clearance: Verify that installed lift will have a minimum headroom of 80 inches above any point on platform floor at any point of travel.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Comply with ASME A18.1 and manufacturer's written instructions for installation of lifts unless otherwise indicated.
- B. Secure lifts to building construction as follows unless otherwise indicated:
 - 1. For concrete and solid masonry anchorage, use post-installed anchors.
 - 2. For hollow masonry anchorage, use toggle bolts.
 - 3. For steel-framed partitions, use hanger or lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.
- C. Wiring Method: Conceal conductors and cables within housings of units or building construction. Do not install conduit exposed to view in finished spaces. Bundle, lace, and route conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
- D. Coordinate runway doors with platform travel and positioning, for accurate alignment and minimum clearance between platforms, runway doors, sills, and door frames.

- E. Position sills accurately and fill space under sills solidly with nonshrink, nonmetallic grout.
- F. Coordinate platform doors with platform travel and positioning.
- G. Adjust stops for accurate stopping at each landing, within required tolerances.
 - 1. Leveling Tolerance: 1/4 inch up or down, regardless of load and direction of travel.
- H. Lubricate operating parts of lift, including drive mechanism, guide rails, hinges, safety devices, and hardware.
- I. Test safety devices and verify smoothness of required protective enclosures and other surfaces.

3.3 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of lift installation and before permitting use of lifts, perform acceptance tests as required and recommended by ASME A18.1 and authorities having jurisdiction.
- B. Operating Test: In addition to acceptance testing, load lifts to rated capacity and operate continuously for 30 minutes between lowest and highest landings served. Readjust stops, signal equipment, and other devices for accurate stopping and operation of system.
- C. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times tests are to be performed on lifts.

3.4 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include three (3) months' full maintenance by skilled employees of lift Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper lift operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lifts. Include a review of emergency systems and emergency procedures to be followed at time of operational failure and other building emergencies.
- B. Check operation of lifts with Owner's personnel present and before date of Substantial Completion. Determine that operating systems and devices are functioning properly.
- C. Check operation of lifts with Owner's personnel present not more than one month before end of warranty period. Determine that operating systems and devices are functioning properly.

END OF SECTION 144200

SECTION 220110 - PLUMBING GENERAL REQUIREMENTS

PART 1: GENERAL

1.1 RELATED DOCUMENTS AND RELATED WORK SPECIFIED ELSEWHERE

A. Related Documents

1. Drawings, Standard General Conditions of the Construction Contract, including Supplementary General Conditions, Division-01 Specification sections and other Division 22 specification sections, and Division 26 specifications apply to work of this section.

1.2 REFERENCES & INTENT

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Study all drawings and specifications before submitting bids.
- C. Work under this Division includes all essential labor, materials, tools, equipment, transportation, insurance, temporary protection, supervision and incidental items for proper installation and operation of all systems even though not specifically mentioned or indicated.
- D. Field verify all building dimensions. The drawings are not to be scaled for final dimensions. However, the equipment is to be installed substantially as shown.
- E. It is the intent of these specifications and drawings to provide for finished systems of the quality specified, properly tested, balanced and ready for operation. This includes all devices and accessories required to make the work complete even though such items may not be expressly shown or specified. Drawings and specifications are complementary and must be so construed to determine the full scope of work.
- F. Job site Conditions. The Contractor shall visit the site and familiarize himself with the existing conditions before submitting this bid. Failure to do so does not relieve the Contractor from completing the work as specified herein and after. Requests for additional payments due to the Contractor's failure to allow for work conditions will be rejected.

1.3 WORK INCLUDED

- A. The following work is specifically included without limiting the generality implied by these specifications and drawings.
 1. All plumbing scope of work as specified herein and as shown on the plans.
 2. Work includes all piping, supports, anchors, insulation, labeling and identification.
 3. All associated cutting and patching.
- B. The service water heating systems for this project will be commissioned by a commissioning agent. The contractor shall provide all material and resources necessary to ensure compliance with the requirements of specification section 01 91 13 – General Commissioning Requirements, and with the requirements of the Commissioning Plan.

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

1.4 STANDARDS AND CODES

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

- B. The following minimum standards apply wherever applicable:

1.	AGA	American Gas Association, Inc.
2.	ANSI	American National Standards Institute, Inc.
3.	ANSI B31.9	Building Services Piping Code
4.	ASME/ASME Code Sec.9	American Society of Mechanical Engineers Boiler and Pressure Vessel Code - Welding and Brazing Qualifications
5.	ASTM	American Society for Testing Materials
6.	AWWA	American Water Works Association
7.	AWWA C651	Disinfecting Water Mains
8.	NBFU	National Board of Fire Underwriters
9.	NEC	National Electric Code
10.	NEMA	National Electrical Manufacturers Association
11.	NFPA	National Fire Protection Association
12.	OSHA	Occupational Safety and Health Act
13.	MSS	Manufacturer's Standardization Society of the Valves and Fittings Industry
14.	UL	Underwriters laboratories, listed Product Directories
15.	North Carolina Plumbing Code, 2012 – International Plumbing Code 2009	

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

1.5 QUALITY ASSURANCE

- A. All work shall be accomplished in a neat, workmanlike manner by experienced journeymen. All work shall be performed at such times as are required by the progress of the job.
- B. Plumbing equipment and fixture installation shall be by a licensed plumber specializing in performing the work of this section with minimum 3 years' experience.
- C. Materials and installation shall be in accordance with North Carolina State Building Code 2012 Edition (Year 2009 of the International Plumbing Code as modified and approved by the NC Building Code Council).

1.6 PERMITS AND FEE

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

1.7 STRUCTURAL STEEL AND CONCRETE

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

1.8 WATERPROOFING

- A. Waterproofed floors and walls may not be penetrated without prior written approval of the Engineer.

1.9 WORK SCHEDULE

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

1.10 PROTECTION OF EQUIPMENT

- A. Provide all necessary protection and be fully responsible for material and equipment stored or installed on the site. Material or equipment stolen or damaged shall be replaced at no additional cost to the Owner.
- B. Provide protection against theft, physical damage and the entry of dirt, water, corrosive fumes into the material and equipment. Maintain protective covers for the duration of construction. Store equipment, such as controls, subject to damage by moisture and temperature extremes in a dry, heated space.

1.11 FIRE SAFETY

- A. Fire Watch: Provide a fire watch wherever welding, brazing, cutting or other processes involving an open flame or potential for generating sparks is used. Fire watch shall consist of a person with a 10-pound carbon dioxide fire extinguisher. While on fire watch, the person so assigned shall have no other duties or assignments.
- B. Fire Blanket: In addition to providing a fire watch, use an approved fire blanket to cover any combustible materials in the immediate area.

1.12 GUARANTEES

- A. Furnish written guarantee in accordance with requirements of General Conditions. Partial approval of a portion of work does not affect the validity of guarantee.

1.13 SUBMITTALS

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

wiring diagrams, configuration, capacity, installation instructions, dimensions including rough-in dimensions, pipe connection sizes, trim, and finishes material, etc., for all items under this Division.

- C. Field verify the characteristics of all specified equipment before preparing shop drawings. This shall include available space, available voltages, suitability of substrate for receiving the specified equipment, etc.
- D. Where different products have to work together, it is the contractor's responsibility to select manufacturers whose products are visually or technically compatible.
- E. Prepare listing of plumbing fixture, specialty items, and piping materials for the project. A sample schedule is included at the end of this section to complete this requirement. Provide all information represented. Plumbing materials shall not be delivered to the building until the Architect has inspected and approved the completed listing.
- F. Submittals of shop drawings and manufacturer's data, etc. shall be provided to the Engineer electronically in PDF format. The Engineer will review the submittals and return them electronically. The exception would be color samples or other material that cannot be adequately represented electronically, and these should be submitted as five (5) hard copies. The Engineer will review them and return three (3) copies.

1.14 RECORD DOCUMENTS

- A. During construction, keep an accurate record of all changes and deviations from contract documents. Upon completion of this installation, the contractor shall submit to the Engineer maintenance manuals and colored scans of the marked-up prints in PDF format indicating any installed work that is different from what is shown on the drawings.
- B. These record drawings shall include detailed locations and depths for all below slab pipes.

PART 2: PRODUCTS

2.1 QUALITY OF MATERIAL

- A. Plumbing equipment manufacturer shall be a company specializing in manufacturing the products specified in this section with minimum three years' experience. Equipment of the same general type shall be of the same make. Brand names and catalog numbers included with equipment or material specifications are used to indicate quality, rating or operating characteristics of the equipment or material.
- B. All materials provided shall be new and shall be approved by the Underwriter's Laboratories, Inc. wherever that agency has applicable standards.

PART 3: EXECUTION

3.1 CLEARANCE AND RESTORATION OF SITE

- A. It may be required to temporarily remove existing ceiling tiles, piping, duct, conduits, etc. to introduce new work as specified in this Division. Contractor, after installation of new work, shall reinstall, reconnect removed items to match the existing. Installation of any new equipment shall not

compromise existing fire ratings of rated assemblies. All penetrations shall be sealed to existing conditions per ALL guidelines for penetration protections. Provide offsets if required in existing piping, ducts etc. to introduce new work.

3.2 COORDINATION

- A. Install all work to permit removal or maintenance of equipment and fixtures without damage to the equipment, fixtures, or the building. Verify equipment space requirements, condition of substrate, voltages, etc. at the time of shop drawing submission and advise the Engineer of any conflict.
- B. Do not rough prior to receipt of approved shop drawings.

3.3 EQUIPMENT ARRANGEMENT AND SUPPORT

- A. Support plumb, rigid and true to line all work, including equipment, fixtures, and piping furnished under this Division. Study thoroughly architectural, mechanical drawings and all related drawings to determine how equipment, fixtures and piping are to be supported, mounted or suspended. Provide extra steel bolts, inserts, pipe stands, brackets and accessories for proper support as required whether or not shown on drawings. When directed, furnish for approval a drawing showing supports.
- B. All gauges, meters and similar items shall be mounted so they are readable without requiring a ladder.

3.4 FINAL ADJUSTMENT AND TESTING

- A. General - Provide all testing, preliminary and final adjustment of instrumentation for this purpose. Conduct all tests in full compliance with applicable codes prior to covering or concealing work by insulation, enclosures, etc. Material found to be defective shall not be repaired. It shall be replaced with new material which tests satisfactorily. Defective workmanship only may be corrected after discovery of defect by tests.
- B. Working Tests - Subject all equipment and controls to simultaneous and continuous working tests for a period of one day prior to final inspection. Make adjustments, repairs and equipment replacements as required.

3.5 LABELS, IDENTIFICATION AND TAGS

- A. Label plumbing equipment and specialty items in conformance with Section 22 05 53 - "Plumbing Identification and Painting".

3.6 OWNER'S RIGHT TO TEST SYSTEMS

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

3.7 CLEANING UP

- A. The contractors performing work under this section shall at all times keep the premises and the building in a neat and orderly condition and any instructions of the Engineer in regard to the storing of material, protective measures, cleaning up of debris, etc. shall be explicitly followed. At the completion of the job, all equipment shall be cleaned to the satisfaction of the Engineer.
- B. Buildings will be occupied during installation of the new addition and/or alterations as described hereinafter. Thus, special care shall be taken during installation to protect equipment and other furniture in the buildings from dust and debris generated during installation of work specified in this Division.

3.8 INSPECTION CERTIFICATES

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

3.9 DESIGNER INSPECTIONS

- A. The Designer will make regular site visits during construction and will keep a deficiency log of all observed exceptions. The contractor shall resolve these noted deficiencies as expediently as possible.

3.10 FINAL REVIEW

- A. Final review and tests of the completed construction shall be performed in the presence of the Engineer or his representative and shall be at such times as are convenient to the Engineer. Final tests shall show conclusively that all fixtures and equipment perform their intended and specified functions and that all work complies with the provisions of these specifications. All material, equipment, and instruments required for the tests shall be furnished by the Contractor at his own expense.
- B. Report new building water shut-off valve location to Facilities Operations for inclusion on emergency plans.

3.11 MAINTENANCE MANUALS

- A. O&M documentation shall be delivered within 60 days of the Contractor receiving approved shop drawings.
- B. Maintenance Manuals shall be submitted in three (3) copies in vinyl 3-ring binders, and three (3) copies in electronic format as PDF files on disks. Each manual shall have the following:
 - 1. Service telephone number of the installing company, including an emergency number.
 - 2. Contact person, phone number, and address of manufacturer or distributor where equipment was purchased.
 - 3. The manufacturing company's operating and maintenance manuals for each piece of equipment.
 - 4. Copies of all approved shop drawings.
 - 5. Copies of warranties with their start dates.
 - 6. A diagram of all valve locations, giving their identification and function. This shall be submitted to the Engineer for review and approval as part of the O&M manual, and to be mounted as indicated below.

- A. Furnish for each building permanent type charts, framed under clear plastic, mounted in at least one mechanical room on each floor or where directed as follows:
1. Service organizations with day and night telephone numbers.
 2. A diagram of all valve locations, giving their identification and function.

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PRODUCTS LISTING FORM**INSTRUCTIONS:**

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

Prepared by: _____

Date: _____ Project: _____

<u>SPEC. SECTION</u>	<u>ITEM</u>	<u>MANUFACTURER</u>

END OF SECTION 220110

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SECTION 220150 - BASIC MATERIALS AND METHODS

PART 1: GENERAL

1.1 RELATED DOCUMENTS AND RELATED WORK SPECIFIED ELSEWHERE

A. Related Documents

1. Drawings, Standard General Conditions of the Construction Contract, including Supplementary General Conditions, Division 01 Specification sections and other Division 22 specification sections, Division 21, Division 23, and Division 26 specifications apply to work of this section.

B. Section 23 0510 - Basic Mechanical Requirements.

C. Section 22 0110 – Plumbing General Requirements.

1.2 DESCRIPTION

- A. Pipe and fittings shall be in accordance with specifications listed herein and shall be installed as outlined under applicable Divisions of the specifications. Materials shall be new and free of manufacturing defects or damage.

1.3 QUALIFICATIONS

- A. The pressure ratings of pipe and fittings shall be compatible with maximum pressures anticipated in respective systems.

PART 2: PRODUCTS

2.1 PIPE AND PIPE FITTINGS (GENERAL REQUIREMENTS)

- A. All above grade water piping 2-1/2" and smaller shall be ANSI/ASTM B88, Type "L" copper, hard drawn, with the type and manufacturer's name on each piece. Fittings shall be wrought brass or copper. Under no circumstances shall notching or mitering be permitted. Appropriate fittings shall be used for all turns, and joints.
- B. All above grade water piping 3" and larger shall be ductile iron with flanged joints.
- C. All below grade water piping 3" and smaller shall be Type "K" copper soft annealed, with the type and manufacturer's name on each piece. Copper tubing which is out of round or kinked will not be acceptable on this project. No joints allowed under the building slab.
- D. Below grade water piping is also permitted to be ductile iron pipe meeting the requirements of ANSI-AWWA C151 Pressure Class 350.
- E. Roof Leader, Storm Drain, Sanitary Soil, Waste and Vent Piping:

1. Above Grade: All 1-1/2" through 8" cast iron soil, waste pipe and house or building sewer lines and fittings shall bear the registered insignia "CI" or "CI No-Hub" indicating that these items used in the sanitary system comply with the Cast Iron Soil Pipe Institute's Standard 301-63T. Universal "Alpha Couplings" or "No-Hub" stainless steel connections shall be used above grade. 1-1/2 and 2-inch galvanized Schedule 40 nipples may be used at wall rough-in for sinks.
2. Below grade: PVC DWV pipe and fittings: ASTM D 2665, Schedule 40, installation per manufacturer's instructions, and connect by ASTM D 2564 PVC solvent cement. Use 2-inch minimum size underground.
3. Fixture Arms: Schedule 40 galvanized steel pipe with threaded fittings.

2.2 PIPE MATERIAL

A. PVC Pipe and fittings below ground waste piping.

1. ASTM D 2665, Schedule 40, installation per manufacturer's instructions, and connect by ASTM D 2564 PVC solvent cement.

B. Cast Iron Soil Pipe and fittings above ground.

1. Cast iron pipe, CISPI 301, hubless, service weight with cast iron fittings. Joints shall be by heavy duty shielded couplings, as specified ASTM C 1540-2 with stainless steel clamp-and-shield assemblies.

C. Copper Piping and Fitting

1. Water Piping Type L and K - Conforming to ASTM B-88 and hard or soft temper as specified elsewhere.
2. Water Pipe Fittings - Cast brass ANSI B-16.18.

D. Standard Cast Iron Fittings

1. 175 PSI WOG, cast iron, screw type, ANSI B-16.4.

E. Cast Iron Drainage Fittings

1. ANSI B-16.12 drainage pattern, standard weight, screw type. Galvanized where specified.

F. Malleable Fittings

1. 150 PSI, SWP malleable iron, screw type, ANSI B-16.3.

2.3 ADAPTORS

A. Cast Iron to Screwed Pipe

1. Half couplings, Schedule 40 steel, galvanized where specified.

B. Cast Iron to Copper

1. Water Service Piping: Dielectric flanged union iron pipe to copper with insulating gasket, 175 PSI rated iron flanges and dielectric space between iron flange and copper pipe. Epco Sales or approved equal.

C. Copper to Screwed

1. Dielectric union with female iron thread to copper solder joint, 250 PSI, with insulating gasket. Epco Sales or approved equal.

2.4 SLEEVES

- A. Refer to Specification Section 221000 – Plumbing Piping and Specialties

2.5 ESCUTCHEONS

- A. General: Use chrome-plated B & C Type 40 flush escutcheons on ceiling and wall. At floors, use Ritter No. 36-A deep cup chrome-plated escutcheon. Use Ritter, Grabler, Blaw-Knox, or equal. Escutcheons shall be used at all piping in finished areas. Escutcheons on insulated piping shall fit insulation tightly.
- B. For Exposed Flush Valves, Water Supplies, and P-traps: Provide chrome-plated cast brass escutcheons with set screws.

2.6 FLASHING

- A. Sheet Lead

1. Sheet lead for general use shall weigh at least 4 pounds per square foot.

- B. Sheet Copper

1. Sheet copper for general use shall weigh at least 12 ounces per square foot and conform to ASTM B152.

PART 3: EXECUTION

3.1 PIPING JOINTS

- A. Cast Iron Soil Pipe (Below Ground)

1. Neoprene gaskets conforming to ASTM C564, as manufactured by Tyler or Charlotte Pipe Foundries for use on service weight or extra heavy weight soil pipe.

- B. Cast Iron Soil Pipe (Above Ground)

1. No hub coupling type joint for two spigots ends of pipe and/or fittings with neoprene sealing sleeves, stainless steel corrugated shield and stainless-steel clamping band.

- C. Threaded Pipe

1. Clean male and female threads. Make up with approved pipe joint compound applied to male thread only. Lead and wicking will not be allowed.

D. Copper Pipe or Tubing

1. Domestic Water: Cut tube end square. Ream and remove burrs. Use steel wool or wire brush to clean both tube and cup to a bright metal.
2. Solder for 1-1/4" Piping and Smaller: Apply non-corrosive flux to outside of tube and inside of cup and solder with 95-5 tin-antimony solder. Remove excess solder. Solder shall be composition Sb5, 95 percent tin, 5 percent antimony conforming to Federal Specifications QQ-S-57 lb. Flux shall be non-corrosive type conforming to Federal Specification O-F-506. Solder containing lead will not be permitted on this project.
3. Silver Brazing Alloy for 1-1/2" to 2-1/2": Silver 15%, copper 80%, phosphorous 5%.

E. Flanged Joints

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

3.2 SLEEVES

- A. Provide for all pipes passing through floors, walls and ceilings.
- B. Sleeves shall be of sufficient size to receive insulation and of proper length to terminate 1" above finished surfaces.
- C. Sleeves for covered lines shall fit over covering without unnecessarily large clearances.
- D. Pipe sleeves shall be caulked with non-hardening caulking to prevent transmission of noise between floors and walls.
- E. Sleeves for piping from mechanical rooms shall be made air and vapor tight by caulking with UL listed fireproof caulking equivalent to 3M CP 25 N/S.

3.3 ESCUTCHEONS

- A. Provide for all exposed piping passing through floors, walls or ceilings of all spaces including equipment rooms.

3.4 FLASHING

A. Vent Piping

1. Sanitary Vent - Extend vent 12 inches above finished roof surface roof insulation.

END OF SECTION 220150

SECTION 220510 - EXCAVATION AND BACKFILL

PART 1: GENERAL

1.1 RELATED DOCUMENTS AND RELATED WORK SPECIFIED ELSEWHERE

A. Related Documents

1. Drawings, Standard General Conditions of the Construction Contract, including Supplementary General Conditions, Division-01 Specification sections and other Division 22 specification sections, Division 21, Division 23, and Division 26 specifications apply to work of this section.

1.2 WORK INCLUDED

A. Provide excavation and backfill for all underground interior and exterior utilities and services provided under this contract including:

1. Excavation and backfill
2. Repair and replacement of grade features to prior condition.

1.3 NOTIFICATIONS

A. Notify the following before commencing any digging.

1. All local utilities, and municipal services including telephone, gas, and electric utilities of construction and or blasting near gas lines, electrical power lines, communication and telephone lines as required by local and State regulations. Obtain and complete necessary forms from respective utilities.

PART 2: PRODUCTS

2.1 BACKFILL

- A. General fill - Approved, clean excavated material, free from frost, stumps, roots, wood, sod, muck, clay, trash, stones or rocks larger than 2" in any dimension, etc.
- B. Pea Gravel - clean graded pea gravel with not less than 95% passing a 12" screen and not less than 95% retained on a #4 screen.
- C. Sand - clean fine-grained sand.
- D. Bank Run Gravel - clean run of bank gravel.

PART 3: EXECUTION

3.1 EXCAVATION

- A. Do all necessary excavation work to proper depth, including removal of all material of any nature and description including all existing brick work, rubble, earth, quicksand, abandoned pipe lines, drains and sewers, rocks, boulders, old concrete, and provide fill, forms, sheet piling, drainage, pumping and work space.
- B. Locate and stake each utility line its entire length before starting. Determine exact location of any underground facilities near proposed new lines.
- C. Verify existing elevations, inverts, and grades before proceeding.
- D. Excavate to proper depth and grade with bottom tamped hard. Excavate holes for bell hub, valve flanges, couplings, etc. Pipe to rest on solid ground.
- E. Remove all wood before backfilling.
- F. Should rock be encountered, excavate 6 inches deeper and fill space between bottom and pipe with sand or bank run gravel, well tamped to form a firm bed.
- G. Maintain sides and slopes of elevations in a safe condition until completion of backfilling. 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 sides of excavation.

3.2 SAFETY PRECAUTIONS

- A. When for any reason work is left unfinished at the end of the work day, all open trenches shall be covered, protected or filled.
- B. Provide lights and barricades to properly protect persons and property.
- C. Where necessary provide properly constructed bridges and walkways, with railings, properly illuminated.

3.3 REMOVAL OF WATER

- A. The contractor shall, at all times during construction, provide and maintain proper and satisfactory means and devices for the removal of all water entering the excavations, and shall remove all such water as fast as it may collect, in such a manner as shall not interfere with the progress of the work.
- B. Provide all necessary pumps, hoses, well points, labor and fuel as required for water removal.
- C. Discharge water in such a manner as not to cause a nuisance or damage to adjacent property.
- D. Provide sheathings, cofferdams, sluiceways, etc., as required.
- E. Provide all maintenance and operation of the same.

3.4 BACKFILL

- A. Piping

1. Backfill around piping with sand.
2. Apply by hand in layers of no more than 8 inches to at least 8 inches above the top of the pipe.
3. Compact under and at sides by mechanical means.
4. Fill remainder of trench in 12-inch layers, of compacted, general fill.

3.5 COMPACTION

- A. Control soil compaction during construction providing minimum percentage of density specified for each area classification.
- B. Compact soil to not less than the following percentages of maximum dry density for soils which exhibit a well-defined moisture-density relationship as determined in accordance with ASTM D 1557; and not less than the following percentages of relative density as determined in accordance with ASTM D 2049, for soils which will not exhibit a well-defined moisture-density relationship.
 1. Lawn or unpaved areas: Compact top 6" of sub-grade and each layer of backfill of fill material to 90% of maximum dry density.
 2. Under roadways, drives, parking areas, floor slabs, and walks: Compact top 12" of sub-grade and each layer of backfill or fill material to 95% maximum dry density or 90 percent relative dry density for cohesive soil material.
- C. Where sub-grade or soil material must be, moisture conditioned before compaction, uniformly apply water to surface of sub-grade, or layer of soil material to prevent free water appearing on surface during or subsequent to compaction operations.
- D. Remove and replace or air-dry soil materials that are too wet to permit compaction to specified density.

3.6 SHORING, BRACING AND SHEATHING

- A. The contractor shall furnish, place and maintain such sheeting, bracing and shoring as may be required to support the sides and ends of excavations in such a manner as to prevent any movement which could, in any way injure the pipe, effect the limits of the site, or other work, diminish the width necessary for construction, or otherwise damage or delay the work.
- B. In no case, will bracing be permitted against pipes or other structures in trenches or other excavations.

3.7 HAULING MATERIAL ON STREETS

- A. When it is necessary to haul material over streets or pavements, the contractor shall provide suitable tight vehicles so as to prevent deposits on the streets or pavements. In all cases where any materials are dropped from vehicles, the contractor will clean up same as often as required to keep the streets and pavements free from mud, dirt, stone and other hauled material. The contractor is responsible for obtaining all State, County, and local permits or variances to allow transport of any and all materials or equipment on public highways.

END OF SECTION 220510

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SECTION 220553 - PLUMBING IDENTIFICATION AND PAINTING

PART 1: GENERAL

1.1 RELATED DOCUMENTS AND RELATED WORK SPECIFIED ELSEWHERE

A. Related Documents

1. Drawings, Standard General Conditions of the Construction Contract, including Supplementary General Conditions, Division-01 Specification sections and other Division 22 specification sections, Division 23, and Division 26 specifications apply to work of this section.

1.2 SCOPE

A. The plumbing contractor shall contract the services of a professional painting subcontractor to do the required painting.

1. Color coded painting of pipes to indicate what is being conveyed in the pipes will not be required.
2. All uninsulated piping and equipment not concealed in chases or above ceilings shall be painted to match surroundings, except for copper piping in mechanical rooms.
3. All insulated piping and equipment exposed to view in public spaces shall be painted unless provided with an aluminum jacket.
4. The plumbing contractor shall be responsible for labeling the plumbing piping and equipment after it is painted.

B. Identify the following:

1. Domestic cold, hot and hot recirculation piping
2. Main domestic cold water shut-off valve, label as "MAIN WATER SHUT-OFF"
3. All plumbing equipment including valves
4. All electrical equipment associated with plumbing, including disconnects, panels or sensors.
5. Provide maintenance and emergency repair contact information for all equipment on labels placed on an easily visible location on the equipment.

1.3 SUBMITTALS

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

PART 2: PRODUCTS

2.1 PLASTIC PIPE MARKERS

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

- B. Lettering: Manufacturer's standard pre-printed nomenclature which best describes piping system in each instance.

- C. Size of Pipe Identification:

	OD Pipe or Covering	Length of Background Color Field	Size of Letters
1.	3/4 in. thru 1-1/4 in.	8 in.	1/2 in.
2.	1-1/2 in. thru 2 in.	8 in.	3/4 in.
3.	2-1/2 in. thru 6 in.	12 in.	1-1/4 in.
4.	8 in. thru 10 in.	24 in.	2-1/2 in.
5.	Over 10"	32 in.	3-1/2 in.

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

2.2 VALVE TAGS

- A. Brass Valve Tags: Provide 19-gage polished brass valve tags with stamp-engraved piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and with 5/32" hole for fastener.
- B. Provide 1-1/2" diameter tags, except as otherwise indicated.
- C. Valve Tag Fasteners: Provide solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves and manufactured specifically for that purpose.

2.3 ENGRAVED PLASTIC-LAMINATE SIGNS AND EQUIPMENT MARKERS

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

PART 3: EXECUTION

3.1 PAINTING

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

damaged. All prime coated equipment shall be thoroughly cleaned and left ready for finish painting. Where cast iron accessories or galvanized pipe, or equipment surfaces are to receive finish painting, the item shall be properly primed.

- B. Ferrous surfaces shall be painted with the following coats:
 - 1. 1 coat of primer equivalent to Bruning Silathane 520-14 grey-green primer, Benjamin Moore 06- 20 red oxide alkyd primer or Richards SR-1399 red metal primer.
 - 2. 2 coats of finish equivalent to Bruning Silathane Gloss Enamel 520-32 quarry gray, Benjamin Moore Gloss Enamel 22-38 or Richards Gloss Enamel 1003 Series.
- C. Refer to Division 09 for more information.
- D. Finish painting of all equipment and piping (both insulated and uninsulated) shall be provided. Where indicated, or specified, existing equipment, piping, duct, etc. shall be cleaned and painted along with new work. Do not paint piping that is provided with aluminum or PVC jacketing insulation covering. Paint piping insulation per color schedule below and provide stenciled identification or plastic pipe markers.

3.2 IDENTIFICATION SCHEDULE

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

	ITEM	IDENTIFICATION	MARKER BACKGROUND COLOR	LETTERING COLOR
1.	Domestic cold water	DCW	Green	White
2.	Domestic hot water	DHW	Yellow	Black
3.	Dom. hot water recirc.	DHC	Yellow	Black

- B. Size of lettering shall be the as indicated in paragraph 2.01.C above.
- C. All other uninsulated ferrous pipes shall be painted light gray with stenciled identification as specified under stenciling.

3.3 GENERAL PLUMBING IDENTIFICATION

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

3.4 PIPING SYSTEM IDENTIFICATION

- A. General: Install plastic pipe markers or stenciling on each system indicated to receive identification.
- B. Locate pipe markers and color bands or stenciling as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch.
 - 3. Near locations where pipes pass through walls, floors, ceilings, roofs or enter non-accessible enclosures.

4. Near major equipment items and other points of origination and termination.
 5. Spaced intermediately at maximum spacing of 25' along each piping run, except reduce spacing to 10' in congested areas of piping and equipment and in mechanical rooms. Lettering shall be readily observable within the room or space where the piping is located.
 6. Exception: Where piping is exposed to public view, identification should be discretely placed for minimal visual impact. Consult Engineer for placement in this type of space.
- C. Stenciling: In lieu of plastic pipe markers, stenciling may be used for identification. Apply stenciling after finished painting has been completed. Stencil indication shall be in block letters, applied with black paint (except white paint on dark surface) as follows:
- D. Stencil as follows:
- | | OD Pipe or Covering | Length of Background Color Field | Stencil Letter Size |
|----|------------------------|----------------------------------|---------------------|
| 1. | 3/4 in. thru 1-1/4 in. | 8 in. | 1/2 in. |
| 2. | 1-1/2 in. thru 2 in. | 8 in. | 3/4 in. |
| 3. | 2-1/2 in. thru 6 in. | 12 in. | 1-1/4 in. |
| 4. | 8 in. thru 10 in. | 24 in. | 2-1/2 in. |
| 5. | Over 10" | 32 in. | 3-1/2 in. |
- E. All underground lines outside the building footprint, shall have a warning tape installed in the backfill between 6 inches to 24 inches below finished grade directly over piping.
1. Metallic lines shall be identified with durable printed plastic warning tapes, minimum 3 inches wide, with lettering to identify buried line below.
 2. Non-metallic pipes shall be marked using an approved tracer. A yellow insulated copper tracer wire or other approved conductor shall be installed adjacent to and over the full length of underground nonmetallic piping. Access shall be provided to the tracer wire or the tracer wire shall terminate at the cleanout between the building drain and building sewer. The tracer wire size shall not be less than 14AWG and the insulation type shall be listed for direct burial.

3.5 VALVE IDENTIFICATION

- A. General: Provide valve tag on every valve, cock and control device in each piping system. List each tagged valve in typed valve schedule for each piping system with diagrams showing their locations, and post under glass in main mechanical room and/or boiler room. Valve schedules and diagrams shall also be included in the O&M manuals.
- B. The contractor shall provide the Contracting Officer with a set of drawings with the valve numbers marked at their installed locations throughout the buildings. These valve numbers shall be included on the as-built drawings at the end of the project.

3.6 PLUMBING EQUIPMENT IDENTIFICATION

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

1. Water heaters
2. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
3. Meters, gages, thermometers and similar units.
4. Pumps and similar motor-driven units.
5. Tanks and pressure vessels.
6. Electrical disconnects for plumbing equipment.

3.7 ACCESS PANEL AND CEILING GRID IDENTIFICATION

- A. Install engraved plastic laminate sign or plastic equipment marker on access panels for concealed plumbing equipment, valves and other operational devices.

END OF SECTION 220553

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SECTION 220700 - PLUMBING INSULATION

PART 1: GENERAL REQUIREMENTS

1.1 RELATED DOCUMENTS AND RELATED WORK SPECIFIED ELSEWHERE:

A. Related Documents

1. Drawings, Standard General Conditions of the Construction Contract, including Supplementary General Conditions, Division 01 Specification sections and other Division 22 specification sections, Division 23, and Division 26 specifications apply to work of this section.

1.2 WORK INCLUDED

A. Provide insulation for piping and equipment installed under this contract, as indicated on the drawings and specified herein, including, but not limited to:

1. Domestic cold, hot water, and hot water recirculation piping, valves and fittings.
2. Exposed drain and hot water piping below handicapped fixtures.
3. Piping carrying cold condensate drainage.

1.3 SUBMITTALS

A. Submit manufacturer's product data on all insulation products specified, including thermal resistance values, flame and smoke ratings, UL listing, and manufacturers published installation recommendations.

1.4 GENERAL REQUIREMENTS

- A. For the purpose of this specification, the term "exposed" is generally intended to mean work that is visible in finished spaces and above partially open ceilings. The term "concealed" is generally intended to mean work that is installed behind walls, plastered ceilings, gypsum board ceilings, continuous lay-in ceilings, and under floors.
- B. Where subject to freezing, cover piping and fittings with single piece, double the thickness normally specified. Areas "subject to freezing" shall be defined as all unconditioned interior spaces and all above grade outdoor spaces.
- C. All insulation, jackets, adhesives, and other insulation materials shall be UL rated, non-combustible, with maximum permanent flame spread rating of 25, and a smoke developed rating of 50 or less and fuel contributed of 50 or less when tested in accordance with ASTM E-84. Submit smoke and flame spread ratings for every material proposed to use.
- D. Unless otherwise indicated, insulation thickness or "R" value shall conform to the North Carolina Energy Code.
- E. Where differences occur between any referenced standard or code the most stringent requirements shall apply.

- F. All products shall be free of asbestos.
- G. All piping insulation shall be performed by a company regularly engaged in piping insulation using full time insulation mechanics.

PART 2: PRODUCTS

2.1 MATERIALS – GENERAL

- A. Type 1 - Thermal Pipe Insulation with Jacket. Preformed Fiberglass Pipe insulation complying with ASTM C547, Class 3, rigid, molded pipe insulation, noncombustible. Maximum K-factor of .24 Btu per inch/h-ft²-°F at mean temperature of 75°F. All insulation shall have a jacket of white kraft paper reinforced with a glass fiber yarn and bonded to an aluminum foil, with self sealing longitudinal laps and butt strips. Jacket shall comply with ASTM C1136 (Type 1). Insulation and jacket shall be equal to Johns Manville Micro-Lok with AP-T Plus, PPG Industries, Owens Corning, Certainteed, or Knauf.
 - 1. Insulate all fittings, valves and strainers with molded fittings, mitered segments of pipe insulation or over- sized pipe insulation held in place with wire. Finish in accordance with manufacturer's recommendations to comply with the UL Systems listing. Preformed jackets of PVC material as manufactured by Zeston, Inc., may be used at fittings.
 - a. Insulation for valves, fittings and unions shall be the same thickness as the pipe insulation by any of the following methods, including both insulation and cover.
 - i. Insulate with one pound per cubic foot density fiberglass blanket wrapped firmly under compression (minimum 2 to 1) and secure with number 20-gauge annealed steel wire.
 - ii. Insulate with molded fiberglass fittings secured with number 20-gauge annealed steel wire.
 - iii. Miter fiberglass piping insulation to form fittings, secured with number 20-gauge annealed steel wire.
 - iv. Cover with Zeston or Johns-Manville premolded one piece PVC fitting covers secured by banding. If additional securing is required, taping and stapling may be used. Covers shall be sealed with vapor barrier pressure sensitive tape. Color to match cover.
 - v. Cover with a smooth coating of Johns-Manville no. 375 cement. Open weave glass fabric to be smoothly adhered and coated with lagging adhesive. Lap glass on fabric at least 1" on itself and 2" on adjoining pipe insulation.
 - vi. Seal all joints and seams with tape as recommended by manufacturer.
- B. Type 2 - Flexible Elastomeric Unicellular Foam Plastic Pipe Insulation.
 - 1. Material: Preformed elastomeric closed cell vapor barrier insulation, flexible, flame retardant, .28 Btu per inch/h-ft²-°F thermal conductivity, by testing conforming to ASTM C 177 or C518. Temperature range 40 to 200 degrees F.
 - 2. Fittings: Sleeve type fitting covers and miter cut pipe insulation or preformed fittings; "Zeston" or equal.
 - 3. Manufacturers - Make

- a. Armstrong - Armaflex AP or Self Seal 2000
- b. Johns Manville - Aerotube II
- c. PPG Industries - Foamed Plastic Pipe Insulation
- d. K-Flex USA

2.2 EXPOSED DRAIN AND HOT WATER PIPING BELOW HANDICAPPED FIXTURES

A. Features and construction

- 1. Prefabricated, removable, insulating covers to fit traps, drains, valves and supplies, extensions for drains, and offset tail pieces.
- 2. Insulating foam liner
- 3. Heavy gauge vinyl cover
- 4. Recloseable sealing seams
- 5. Tamperproof locking straps
- 6. Weep seams to prevent leakage build-up.
- 7. Conforms to Uniform Federal Accessibility Standards 4.19.4 GSA and ANSI Document A117-1- 1980
- 8. White color

B. Manufacturer

- 1. Plumberex Specialty Products - Handy-Shield Safety Covers.
- 2. Brocar Products Inc. - Trap Wrap
- 3. Trueboro, Inc. – Lav Guard

2.3 FIELD APPLIED JACKETS

- A. Canvas Jacket: UL listed fabric, 8 oz/sq yd, plain weave cotton treated with dilute fire-retardant lagging adhesive.
- B. Aluminum Jacket: 0.016-inch-thick sheet, embossed finish, with longitudinal slip joints and 2-inch laps, die shaped fitting covers with factory attached protective liner.

PART 3: EXECUTION

3.1 GENERAL

- A. Apply insulation in strict accordance with manufacturer's instructions.
- B. All surfaces must be free of dirt, dust, grease, oil, scale or loose particles before insulation.
- C. Do not cover fittings until required tests have been completed and accepted.
- D. Insulation shall be continuous passing through walls. Size sleeves accordingly to accommodate insulation. Where insulation passes through floor or wall sleeves, pack the space outside of the insulation and inside of the sleeve with fiberglass blanket. Seal with fire rated sealant on fired rated partitions.
- E. For cold lines for condensation protection or for safety protection of hot lines unions shall be insulated as follows: Covering shall be terminated at each end of the union and sealed. Cover

union with separate section of insulation, routed out to fit over union, of section of pipe insulation whose inside diameter matches the outside diameter of the adjoining insulation, lap adjoining insulation on both sides by 3", seal vapor tight plastic tape.

- F. Provide insulation saddles and shields at hangers to prevent deformation or penetration of insulation by contact with hangers.

3.2 DOMESTIC WATER PIPING

- A. Type 2- for cold water piping, 1/2 " thickness for all piping up to and including 1-1/2". 1" thickness for pipes 2" and above.
- B. Type 2- Double insulation thickness for cold water piping subject to freezing.
- C. Type 1 or Type 2- for hot water piping and hot water recirculation piping, 1" thickness for piping up to and including 1", 1-1/2" thickness for all piping larger than 1".

3.3 EXPOSED WASTE AND HOT WATER PIPING AT FIXTURE DESIGNATED HANDICAPPED

- A. Prefabricated insulating covers, securely installed in accordance with manufacturers instructions.

3.4 FIELD APPLIED JACKETS

- A. Provide canvas or PVC jackets where piping is exposed to view in the gymnasium.
- B. Provide PVC jackets where piping is exposed to view in the kitchen.
- C. Provide PVC or aluminum jackets where insulated piping is exposed in mechanical, plumbing, storage, or similar utilitarian rooms.

END OF SECTION 220700

SECTION 221000 - PLUMBING PIPING AND SPECIALTIES

PART 1: GENERAL

1.1 RELATED DOCUMENTS AND RELATED WORK SPECIFIED ELSEWHERE:

A. Related Documents

1. Drawings, Standard General Conditions of the Construction Contract, including Supplementary General Conditions, Division 01 Specification sections and other Division 22 specification sections, Division 21, Division 23, Division 26, and Division 31 specifications apply to work of this section.

1.2 REFERENCED SECTIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Specification Divisions and Sections as referenced in Division 22 Section "Plumbing General Requirements", and Division 22 Specification Sections as follows apply to work of this section:
- C. Section 220110 - Plumbing General Requirements
- D. Section 220150 - Basic Materials and Methods
- E. Section 220700 - Plumbing Insulation
- F. Section 224000 - Plumbing Fixtures

1.3 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.
 1. AMERICAN GAS ASSOCIATED LABORATORIES (AGA)
 - a. AGA American Gas Association Laboratories Listing.
 2. AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)
 - a. ASSE 1010 Water Hammer Arrestors
 - b. ANSI/ASSE 1011 Performance Requirements for Hose Connection Vacuum Breakers
 - c. ASSE 1012 Backflow Preventers with Immediate Atmospheric Vent
 - d. ASSE 1013 Backflow Preventers, Reduced Pressure Principle
 - e. ASSE 1019 Wall Hydrants, Frost Proof Automatic Draining Anti-Backflow Types
 3. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
 - a. ANSI A112.21.1M Floor Drains

- b. ANSI A112.21.2M Roof Drains
 - c. ANSI A112.26.1 Water Hammer Arrestors
 - d. ANSI B16.18 Cast Copper Alloy Solder Joint Pressure Fittings
 - e. ANSI B16.23 Cast Copper Alloy Solder-Joint Pressure Fittings - DWV
 - f. ANSI B31.2 Fuel Gas Piping
 - g. ANSI B31.9 Building Services Piping Code
- 4. AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)
 - a. ANSI/ASHRAE 90.1B Energy Conservation in New Building Design
- 5. AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
 - a. ANSI/ASME Code Boiler Pressure Vessel Code
 - b. ANSI/ASME Code Sec.9 Boiler and Pressure Vessel Code - Welding and Brazing Qualifications
 - c. ANSI/ASME A112.19.8M Certification of Suction Fittings & Drains
 - d. ANSI/ASME B16.1 Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800.
 - e. ANSI/ASME B16.3 Malleable-Iron Threaded Fittings, Classes 150 and 300
 - f. ANSI/ASME B16.4 Cast-Iron Threaded Fittings Class 125 and 250
 - g. ANSI/ASME B16.22 Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
 - h. ANSI/ASME B16.26 Cast Copper Alloy Fittings for Flared Copper Tubes
 - i. ANSI/ASME B16.29 Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV
 - j. ANSI/ASME B16.32 Cast Copper Alloy Solder-Joint Fittings for Solvent Drainage Systems
- 6. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - a. ASTM A 47 Ferritic Malleable Iron Castings
 - b. ASTM A 53 Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless
 - c. ASTM A 74; CIS {O 3-1, Cast Iron Soil Pipe and Fittings ASTM A888
 - d. ASTM A 234/A234M Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
 - e. ASTM B 32 Solder Metal

f.	ASTM B 42	Seamless Copper Pipe, Standard Sizes
g.	ASTM B 43	Seamless Red Brass Pipe
i.	ASTM B 62	Cast Bronze Valves
j.	ASTM B 75	Seamless Copper Tube
k.	ASTM B 88	Seamless Copper Water Tube
l.	ASTM B 251	Wrought Seamless Copper and Copper-Alloy Tube
m.	ASTM B 302	Threadless Copper Pipe (TP)
n.	ASTM B 306	Copper Drainage Tube (DWV)
o.	ASTM B 447	Copper or Copper Alloy Tubing
p.	ASTM C 1540	Heavy duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings
q.	ASTM C 564	Rubber Gaskets for Cast Iron Soil Pipe and Fittings
7. AMERICAN WELDING SOCIETY (AWS)
- | | | |
|----|---------------|----------------------|
| a. | ANSI/AWS A5.8 | Brazing Filler Metal |
|----|---------------|----------------------|
8. AMERICAN WATER WORKS ASSOCIATIONS (AWWA)
- | | | |
|----|-----------------------|--|
| a. | ANSI/AWWA C105/A21.5 | Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids |
| b. | ANSI/AWWA C151/A21.51 | Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids |
| c. | ANSI/AWWA C110/A21.10 | Ductile - Iron and Gray - Iron Fittings 3 in. through 48 in., for Water and Other Liquids |
| d. | ANSI/AWWA C111/A21.11 | Rubber Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings |
| e. | AWWA C506 | Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valve Types |
| f. | AWWA C651 | Disinfecting Water Mains |
9. CAST IRON SOIL PIPE INSTITUTE (CISPI)
- | | | |
|----|-----------|---|
| a. | CISPI 301 | Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems |
| b. | CISPI 310 | Joints for Hubless Cast Iron Sanitary Systems |
10. NATIONAL CERTIFIED PIPE WELDING BUREAU (NCPWB)
- | | | |
|----|---|--|
| a. | NCPWB Procedure Specifications for Pipe Welding | |
|----|---|--|
11. NATIONAL FIRE PROTECTION ASSN (NFPA)
- | | | |
|----|---------|--------------------------|
| a. | NFPA 70 | National Electrical Code |
|----|---------|--------------------------|
12. NATIONAL SANITATION FOUNDATION (NSF)
- | | | |
|----|-----------|---|
| a. | NSF Std 5 | Commercial Hot Water Generating and Heat Recovery Equipment |
|----|-----------|---|

13. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- a. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum)

14. PLUMBING AND DRAINAGE INSTITUTE (PDI)

- a. PDI WH-201 Water Hammer Arresters

15. UNDERWRITERS LABORATORIES (UL)

- a. UL 1453 Electric Booster and Commercial Storage Tank Water Heaters
- b. UL listed Product Directories

1.4 SUBMITTALS

- A. Submit under provisions of Division 01, and Division 22, "Plumbing General Requirements" the following: manufacturer's catalog data, installation, dimensions (including rough in dimensions) and operating and maintenance data for plumbing specialty items; catalog data and material certification for pipe materials and fittings. Provide for all items as listed in Specification Section 220110.

1.5 QUALITY ASSURANCE

- A. Equipment of the same general type shall be of the same make.
- B. Brand names and catalog numbers included with equipment or material specifications are used to indicate quality, rating or operating characteristics of the equipment of material.
- C. All materials provided shall be new and shall be approved by the Underwriter's Laboratories, Inc. wherever that agency has applicable standards. All work shall be accomplished in a neat, workmanlike manner by experienced journeymen. All work shall be performed at such times as are required by the progress of the job.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years' experience.
- B. Installer: NC State licensed plumber specializing in performing the work of this section with minimum 3 years' experience.

1.7 REGULATORY REQUIREMENTS

- A. Installation and materials shall be in conformance with the North Carolina State Building Code 2012 Edition (Year 2009 Edition of the International Plumbing Code as modified and adopted by the North Carolina Building Code Council).

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Division 01 and Division 220110, Plumbing General Requirements.

1.9 SYSTEM COMPLETION

- A. Provide all bolts, nuts, gaskets, sleeves, hangers, supports, miscellaneous valves and fittings, and specialties required for complete installation of the piping and equipment to be provided.

PART 2: PRODUCTS

2.1 BURIED WASTE AND STORM DRAIN PIPING

- A. Below grade: PVC DWV pipe and fittings: ASTM D 2665, Schedule 40, installation per manufacturer's instructions, and connect by ASTM D 2564 PVC solvent cement. Use 2 inch minimum size underground.
- B. Contractor's Option below grade: Cast iron pipe, ASTM A 74, service weight with cast iron fittings. Joints shall be either 1) hub-and spigot joints, CISPI HSN compression type with ASTM C 564 neoprene gaskets.

2.2 ROOF DRAIN AND SANITARY DRAIN PIPING ABOVE GROUND

- A. Cast iron pipe: All 1-1/2" through 8" cast iron soil, waste pipe and house or building sewer lines and fittings shall bear the registered insignia "CI" or "CI No-Hub" indicating that these items used in the sanitary system comply with the Cast Iron Soil Pipe Institute's Standard 301-63T. Universal "Alpha Couplings" or "No-Hub" stainless steel connections shall be used above grade.
- B. Fixture Arms: Schedule 40 galvanized steel pipe with threaded fittings.

2.3 WATER PIPING

- A. All above grade water piping 2-1/2" and smaller shall be ANSI/ASTM B88, Type "L" copper, hard drawn, with the type and manufacturer's name on each piece. Fittings shall be wrought brass or copper. Under no circumstances shall notching or mitering be permitted. Appropriate fittings shall be used for all turns, and joints.
- B. All above grade water piping 3" and larger shall be ductile iron with flanged joints.
- C. All below grade water piping 3" and smaller shall be Type "K" copper soft annealed, with the type and manufacturer's name on each piece. Copper tubing which is out of round or kinked will not be acceptable on this project. No joints allowed under the building slab.
- D. Below grade water piping is also permitted to be ductile iron pipe meeting the requirements of ANSI-AWWA C151 Pressure Class 350.
- E. Fittings shall be wrought copper, ANSI B16.22, or cast brass, ANSI B16.18, with solder joints. Solder for potable water systems shall be lead free, 95 /5 Tin/Antimony. Joints on piping 1-1/2" and larger shall be silver brazed. Under no circumstances shall notching or mitering be permitted. Appropriate fittings shall be used for all turns, and joints.
- F. Below Ground piping shall have coal tar protective coating (comply with AWWA C203 for enamel and tape, hot applied.) Avoid use of underground fittings. Where underground fittings are required, provide wrought copper and connect by silver brazing.

- G. Solder: 95-5 tin - antimony solder. Solders containing lead shall not be used on potable water systems.

2.4 DIELECTRIC CONNECTORS

- A. Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.5 ESCUTCHEONS

- A. General: Use chrome-plated B & C Type 40 flush escutcheons on ceiling and wall. At floors, use Ritter No. 36-A deep cup chrome-plated escutcheon. Use Ritter, Grabler, Blaw-Knox, or equal. Escutcheons shall be used at all piping in finished areas. Escutcheons on insulated piping shall fit insulation tightly.
- B. For Exposed Flush Valves, Water Supplies, and P-traps: Provide chrome-plated cast brass escutcheons with set screws.

2.6 FLASHING

- A. Sheet lead for general use shall weigh at least 4 pounds per square foot. Sheet copper for general use shall weigh at least 12 ounces per square foot and conform to ASTM B152.

2.7 SLEEVES

- A. Pipe Sleeves with Link Seal below grade: Modular mechanical type wall sleeve seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall sleeve. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with pressure plate under each bolt head and nut. Tightening of the bolts shall cause the rubber links to expand and provide a positive weather tight seal between the pipe and the wall sleeve. Mechanical wall sleeve seals shall be "Link-Seal" model as manufactured by Thunderline Corporation, Wayne Michigan, Wade, Zurn, or equal.
- B. Walls and Floors
 1. Sleeves through poured through concrete walls and floors, and non-bearing partition walls shall be linear polyethylene as manufactured "Crete Sleeve", Sperzel Division, Tyler, or Charlotte Pipe.
 2. Sleeves through waterproof floors or where exposed in rooms with floor drains shall be coated cast iron with flashing device and under deck clamp. J.R. Smith #1720, Josam, Wade or Zurn.
 3. General Provision for Sleeves: Provide sleeves for all pipe passing through masonry fire walls, floors, foundation walls or ceilings of concrete or masonry construction, provide a Schedule 40 galvanized steel pipe large enough to clear pipes by 1/4 inch all around. No sheet metal sleeves are to be permitted. All floor sleeves shall extend 1/2 inch above floor. Sleeves at walls and ceilings shall be flush at wall lines. For insulated pipes, sleeves shall be larger than the outside diameter of the insulation and insulation shall be continuous through the sleeves. Sleeves shall be machine cut at right angles to centerline of pipe and deburred. No flame cut sleeves will be permitted.

2.8 FLOOR DRAINS

- A. ANSI A112.21.1, coated cast iron two-piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer. All floor drains shall have round tops, except where square tiles are employed provide square tops. Provide tractor grate, perforated stainless steel basket or sediment bucket, funnels, and trap primer connections where called for in the Plumbing Specialties Schedule.
- B. Provide Series 30000 as manufactured by Josam, or equal by Zurn, Jay R. Smith, or Wade.
- C. Use deep seal p-traps with all floor drains.

2.9 CLEANOUTS

- A. Cleanouts shall be adjustable and equipped with an internal brass plug with countersunk brass screws holding the rim to the body and cover. Provide tops with tile recess for floor coverings or terrazzo. Provide a permanent carpet indicator where cleanout is located under carpet. Line type shall have lacquered cast iron body and round epoxy coated gasketed cover. Wall cleanouts shall have stainless steel round access covers, frame with anchor lugs and cover plate with screws; as manufactured by Josam, or equal by Zurn, Jay R. Smith, or Wade.
- B. Exterior cleanouts shall be brass recessed type protected by 24"x24"x 6" thick concrete pad poured to finished grade.

2.10 HOSE BIBBS

- A. Bronze or brass with integral adjustable mounting flange, hose thread spout, integral vacuum breaker, hand wheel or loose key operated as indicated in Plumbing Specialties Schedule on the drawings, in conformance with ANSI/ASSE 1011; as manufactured by Woodford, Wilkins, Watts, Jay R. Smith, Nibco, or Crane.
- B. All hose bibbs exposed to public view shall have chrome plated finish.

2.11 WALL HYDRANT

- A. Non-freeze hot and cold type with 3/4" hose thread spout, chrome plated, drains automatically when hose is removed, internal resetting pressure relief valve to prevent faucet casing tube from bursting if hose is left on in freezing conditions, with two independent check valves, ASSE 1052 approved, listed by IAPMO; as manufactured by Wilkins, J.R. Smith, Nibco, Crane, Woodford, or Watts.
- B. Provide a loose tee key for each hydrant to the owner.

2.12 VACUUM BREAKERS

- A. Atmospheric type – bronze body and trim with 212F temperature rating, 125 PSI working pressure, bottom inlet, side outlet, and silicone sealing disc. Provide polished chrome finish where exposed in finished areas.

2.13 THERMOSTATIC MIXING VALVES

- A. Thermostatic mixing valves shall meet ASSE 1069 and 1070 requirements. The point of use master controller valve shall be a nickel plated thermostatic mixing valve with 3/4" MNPT connections. The

mixing valve shall have a spindle to adjust outlet temperature. The mixing valve shall protect against scalding and chilling. Outlet temperature range shall be 95 to 115 degrees F with a temperature stability of +/- 5 degrees F, and minimum flow rate of 0.5 gpm. Provide Model 570 Lead Free as Manufactured by Lawler MFG Co., Inc. or approved equal by Haws, Leonard Water Temperature Controls, or Watts.

2.14 TRAP SEAL PRIMERS

- A. Install where shown on the drawings and use the type indicated on the drawings for a specific location.
 - 1. TP-1: Activated by a pressure drop of 10 psig, Model P2-500 as manufactured by Precision Plumbing Products, or approved equal by Sloan, Delta, or Zurn.

2.15 WATER HAMMER ARRESTORS

- A. ANSI A112.26.1; All stainless-steel construction, meets standards PDI WH-201 and ASSE 1010, filled with glycerin, pressurized with argon or nitrogen, size as indicated by PDI WH 201 letter designation; Series 75000-S as manufactured by Josam, or equal by J.R. Smith, Watts, or Zurn. Install where shown on the drawings.

2.16 BUTTERFLY VALVES

- A. MSS SP-67: Butterfly Valves shall be lead free full-tapped lug design suitable for dead-end service. Valves through 6" shall have infinite position handles equipped with adjustable memory stops. Valves shall be suited for working pressure up to 150 psi and 275 F, shall have cast iron body, ductile iron discs, stainless steel shaft, and elastomeric seats and o-rings. Provide with stem extension for insulated pipe applications.

2.17 ANGLE VALVES

- A. Up to and including 2 Inches: Lead-free, MSS SP-80, Class 150, body and union bonnet of ASTM B 62 bronze, inside rising stem of bronze, brass packing gland, Teflon-impregnated packing, and malleable-iron handwheel.
- B. Up to and including 2 Inches: Lead-free, Class 300, body and union bonnet of ASTM B 61 bronze, inside rising stem of bronze, plug disc and seat ring of stainless steel, and malleable-iron handwheel.
- C. Over 2 inches: Lead-free Class 125, Iron body, MSS SP-85, bronze mounted with body and bonnet ASTM A 126, Class B cast iron, flanged ends, outside screw and yoke, with Teflon-impregnated packing and two-piece packing gland assembly, and malleable-iron handwheel.

2.18 CHECK VALVES

- A. Up to and Including 2 Inches: Lead-free, Class 125 or Class 150, body and caps of ASTM B584-C89836 bronze, renewable bronze seat, threaded ends or solder ends, and swing type disc.

2.19 BALL VALVES

- A. Up to and Including 4": Lead-free, 400 psig CWP, 150 psig SWP, bronze body, 3-piece full port, adjustable packing gland, reinforced seats, blow-out-proof stem, inline repairable, chrome-plated brass ball, threaded, or soldered ends.

- B. Provide with stem extension for insulated pipe applications.

2.20 STRAINERS

- A. Size 2 Inches and Under: Lead-free, screwed bronze cast iron body for 175 psig working pressure, Y pattern with 1/32-inch perforated stainless-steel screen.
- B. Each strainer with gate-type drain valve with 3/4-inch hose nipple and cap.

PART 3: EXECUTION

3.1 EXAMINATION

- A. Verify that excavations are required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Coordinate cutting and forming of roof and floor construction to receive drains to required invert elevations.

3.3 INSTALLATION

- A. Install all equipment in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever joining dissimilar metals. Protect insulating material if heat is applied to fitting.
- C. Route piping in orderly manner. Grade piping to low points and provide drain valves.
- D. Install piping to conserve building space and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Provide Sleeves for all pipes passing through floors, walls and ceilings, of sufficient size to receive insulation and of proper length to terminate 1" outside finished surfaces. Pipe sleeves shall be caulked with non-hardening caulking to prevent transmission of noise between floors and walls.
- H. Pipe Penetrations through fire partition walls and through floors shall be made by UL penetration detail as indicated with caulking with UL listed fireproof caulking.
- I. Provide clearance for installation of insulation and access to valves and fittings.

- J. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with those specified in Division 05.
- K. Establish elevations of buried piping outside the building to ensure not less than 3 ft of cover, except where noted otherwise.
- L. Piping buried under slab within building shall be installed with a minimum of joints and shall be completely encased in sand.
- M. Changes in pipe sizes shall be made with reducing fittings.
- N. Make copper piping joints for 1-1/4" pipe and smaller with 95-5 solder, and no corrosive solder paste. Flux and solder combinations are not permitted. Make copper piping joints for 1-1/2" to 2-1/2" with silver brazing.
- O. Provide domestic water branch piping to fixtures and make final connections to fixtures provided by this or other contractors.
- P. Do not rough piping inside spaces, partitions, stud wall voids, plenums, or cavities subject to potential freezing.
- Q. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- R. Provide escutcheons for piping passing into finished areas. All uninsulated piping in finished areas shall be chrome plated.
- S. Hangers supports and threaded rods shall be furnished galvanized, except where attached to copper pipe. Clamps or other attachments on copper piping shall be copper or copper plated steel.
- T. Prepare pipe and accessories not prefinished, ready for finish painting. Refer to Division 09 and Section 220553.
- U. Excavate in accordance with Section 220510 for work of this Section.
- V. Backfill in accordance with Section 220510 for work of this Section. All underground lines shall be marked with magnetic tape installed in the backfill at least 6" below grade.
- W. Install bell and spigot pipe with bell end upstream.
- X. Provide valves at inlet and outlet of each piece of equipment, at each fixture, on branch lines and where indicated on the drawings.
- Y. Install valves with stems upright or horizontal, not inverted.
- Z. Install all devices in accordance with manufacturer's instructions.
- AA. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system. Encase exterior cleanouts in concrete flush with grade.

- BB. Install water hammer arrestors complete with accessible isolation valve on hot and cold-water supply piping to lavatories, sinks, and water closet flush valves.

3.4 APPLICATION

- A. Use grooved mechanical couplings and fasteners only in accessible locations.
- B. Install unions downstream of valves and at equipment or apparatus connections.
- C. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.
- D. Install gate or ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- E. Install ball valves for throttling, bypass, or manual flow control services.

3.5 ERECTION TOLERANCES

- A. Establish invert elevations, slopes for drainage to 1/8 or 1/4 inch per foot, as required. Maintain gradients. Slope water piping and arrange to drain at low points.

3.6 PLUMBING SYSTEM TESTING

- A. Water: Upon completion of a section of, or entire water distribution system, the system, or portion completed, shall be tested and proved tight under a water or an air test of not less than 100 psi. This pressure shall be held for not less than 15 minutes.
- B. Waste and Vent: A water test shall be applied to the drainage system within the building either in its entirety or in sections. If applied to the entire system, all openings in the piping shall be tightly closed, except the highest opening, and the system shall be filled with water to the point of overflow. When testing in sections, each opening shall be tightly plugged except the highest openings of the section under test, and each section shall be filled with water, but no section shall be tested with less than a 10-foot head of water. In testing successive sections, at least the upper 10 feet of the next preceding section shall be tested so that no joint or pipe in the building, except the uppermost 10 feet of the system, shall have been submitted to a test of less than a 10-foot head of water. This pressure shall be held for not less than 15 minutes. The system shall then be tight at all points.

3.7 POTABLE WATER SYSTEM STERILIZATION

- C. All pipe and fittings connected to and forming a part of a potable water supply shall be sterilized. Sterilization shall be accomplished after the pipe has passed the hydrostatic pressure tests. The method used by the contractor shall be in full accordance with the requirements of the AWWA Specification C-601, and state and local Departments of Health.
- D. All new piping shall be filled with not less than 25, nor more than 50 parts per million (ppm) of available chlorine and held in contact with such for not less than 24 hours. Final tests after 24 hours shall show minimum residual chlorine content of 25 ppm in all parts of the system. All chlorine introduced into the system shall be totally dissolved. The introduction of solid hypochlorite directly into the system is prohibited.

- E. Sterilization tests shall be repeated as often as necessary and as directed by the engineer and/or Department of Health, until the minimum residual chlorine content has been maintained. The chlorine solution shall be thoroughly flushed prior to placing the new sections of piping in service. The contractor is cautioned that the spent chlorine solution must be disposed of in such a way as not to be detrimental to plant, animal or aquatic life.
- F. After disinfection, the water system shall not be placed in service until bacteriological test results of representative water samples analyzed in an independent, EPA approved laboratory, are found to be satisfactory. Certification of bacteriological testing for quality of the domestic water shall be conducted, accepted by the Project Engineer and submitted to the State Construction Office prior to requesting Beneficial or Final Occupancy Permit.

END OF SECTION 221000

SECTION 224000 - PLUMBING FIXTURES

PART 1: GENERAL

1.1 RELATED DOCUMENTS AND RELATED WORK SPECIFIED ELSEWHERE:

A. Related Documents

1. Drawings, Standard General Conditions of the Construction Contract, including Supplementary General Conditions, Division 01 Specification sections and other Division 22 specification sections, Division 21, Division 23, and Division 26 specifications apply to work of this section.

B. Section 22 01 10 - Plumbing General Requirements

C. Section 22 10 00 - Plumbing Piping and Specialties

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation.

1. Air conditioning and refrigeration institute (ARI)

- a. ANSI/ARI 1010 Drinking Fountains and Self-Contained, Mechanically Refrigerated Drinking Water Coolers.

2. AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

- a. ANSI/ASME A112.6.1M Supports for Off-the-Floor Plumbing Fixtures for Public
 - b. ANSI/ASME A112.18.1M Plumbing Fixture Fittings
 - c. ANSI/ASME A112.19.2M Vitreous China Plumbing Fixtures
 - d. ANSI/ASME A112.19.3M Stainless Steel Plumbing Fixtures
(Designed for Residential Use)
 - e. ANSI/ASME A112.19.5 Trim for Water Closet Bowls, Tanks, and Urinals
 - f. ANSI/ASME A112.19.6 Hydraulic performance Requirements for Water closets and Urinals

3. AMERICAN SOCIETY OF SANITARY ENGINEERS (ASSE)

- a. ASSE 1037 Pressurized Flushing Devices Flushometers) for Plumbing Fixtures

- 1.3 Submit under provisions of Division 1 and Division 22 "Plumbing General Requirements": listing of plumbing fixtures, including manufacturer's catalog data, installation instructions, dimensions including rough-in dimensions, pipe connection sizes, trim, and finishes. Provide certification from Manufacturer that lead based solders were not used in fabrication of electric water coolers or fountains. No fixtures shall be delivered to the building until the Engineer has inspected and approved the complete listing of fixtures.
- 1.4 Perform Work in accordance with State of North Carolina Building Code (International Plumbing Code as modified by the NC Code Council).
- 1.5 Deliver products to site, store, protect, and handle under provisions of Division 1. Accept fixtures on site in factory packaging. Inspect for damage. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.
- 1.6 Verify that the field measurements are consistent with the dimensions as indicated on approved shop drawings. Confirm that millwork is constructed with adequate provision for the installation of countertop fixtures.

PART 2: PRODUCTS

- 2.1 Unless specifically indicated otherwise, each plumbing fixture shall be provided with a trap, waste, and water fittings with connections as indicated, each plumbing fixture shall be provided complete for the specified function (including water inlet(s) and waste outlet(s)), and except for stainless steel fixtures, the fixture color shall be white. Use the same manufacturer for each grouping of faucets, valves, flush valves, etc. for the entire building.
- 2.2 Vitreous china plumbing fixtures, ASME 112.19.2M, shall be thoroughly fused so that a fractured surface shall show a homogeneous mass, free from pores and with close grain. Glaze shall cover all surfaces that are exposed when the fixture is installed in its normal manner. Vitreous china fixture manufacturers shall be American Standard, Eljer, Kohler, Toto, Sloan, or Crane.
- 2.3 Stainless steel fixtures, 302 or 304 stainless steel, of the specified thickness (but of a minimum of 20 gauge) and undercoated with a sound absorbent material. Provide drillings to match faucet selection, stainless steel or chrome plated brass strainer, with trap and tailpiece to match.
- 2.4 Make terrazzo mop receptors of marble chips cast in white portland cement to produce a compressive strength of not less than 3000 psi 7 days after casting. Provide brass body drains with chromium plated strainers cast integral with terrazzo.
- 2.5 Exposed piping, trimming and fittings shall be chromium or nickel-plated brass with polished surfaces. Floor and wall plates shall be chromium plated brass.
- 2.6 FLUSHOMETER TYPE WATER CLOSETS
 - A. Flushometer Type Water Closets, ANSI/ASME A112.19.2M, white vitreous china, floor mounted floor outlet, siphon jet, 1-1/2" top spud, elongated bowl with white, solid, plastic, elongated open-front seat, and ANSI A112.19.5 trim. The inside of water closet bowl trapways shall be glazed. Provide ANSI/ASME A112.6.1M carrier with feet.

- B. Flush valves shall be manually operated, exposed type and furnished with integral stop valve, solid ring support, backflow preventer and flush pipe. Provide not less than 3 inches in diameter diaphragm non-hold-open flushometer including vacuum breaker and angle control-stop valve. The water flushing volume of the flushometer and water closet combination shall not exceed 1.28 gallons per flush. Flush valve supply pipe shall be threaded brass pipe. The flush valve hydraulics shall conform to ASME A112.19.6 and ASSE 1037 and shall be capable of operation without chattering or water hammer, at any inlet pressure from 20 to 50 psi. Provide straight or angle type stop as required to suit flush valve.
- C. Handicapped Water Closets and trim shall be specified by the manufacturer to compliance with the ADA. The top of the seat of the handicapped toilet shall be 17" to 19" above finished floor.
- D. Water Closet Manufacturers: Kohler, Toto, American Standard, Crane, Eljer, or Sloan.
- E. Flush Valve Manufacturer: Sloan Model Royal 111-1.28 or approved equal by Delaney (Flushboy series), Delta, Kohler, Toto, Zurn, or the manufacturer of the water closet provided.

2.7 URINALS

- A. Urinals, Flushometer Type, ANSI/ASME A112.19.2M, white vitreous china, wall-mounted, wall outlet, washout, integral trap, extended side shields, and ANSI/ASME A112.19.5 trim. Provide exposed, manually operated, large (not less than 3 inches in diameter diaphragm non-hold-open flushometer including vacuum breaker and angle (control-stop) valve, with solid ring support. The water flushing volume of the flushometer and urinal combination shall not exceed 0.125 gallon per flush; urinal manufacturer shall furnish certification of compliance.
- B. Provide ANSI/ASME A112.6.1M concealed wall hangers with thru-bolts and back plates for mounting.
- C. Urinal chair carriers consisting of a pair of cast-iron feet bolted to or imbedded into the floor together with 1.66-inch outside diameter (minimum), steel tubular upright members, steel hanger support plate, and steel bearing plate connected to cast iron or steel adjustment sleeves and furnished with necessary bolts, nuts, washers, and chrome plated trim. Provide chair carrier that is fully concealed in the building construction and that supports the fixture in such a manner that no part of the fixture will be supported by the wall or the partition.
- D. Handicap urinals and trim shall be certified by the manufacturer to comply with ADA when installed to ADA guidelines. Rim of urinal shall be a maximum of 17" above finished floor.
- E. Urinal Manufacturers: Kohler, American Standard, Toto, Crane or Sloan.
- F. Flush Valve: Sloan Model 186-0.125 or approved equal by Delaney (Flushboy series), Delta, Zurn, or by the manufacturer of the urinal provided.

2.8 LAVATORIES

- A. Lavatory: drop-in, white vitreous china, front overflow, chrome plated grid drain, American Standard Rondalyn 0490.156, or equivalent by Kohler, Eljer or Crane.
- B. Provide commercial grade ANSI/ASME A112.18.1M and ADA compliant faucets of brass casting with a polished chromium plated finish, quality equal to that as listed in the schedule on the drawings,

single lever faucets, with vandal resistant 0.5-gpm aerator. Provide perforated grid strainers, and 1-1/4-inch adjustable chrome plated cast brass P traps with ground joint and cleanout plug. Tubular trap shall have a wall thickness of at least 17 gauge.

1. Manufacturer: Kohler, Moen, Delta Teck, American Standard, Chicago Faucets, T&S Brass, Sloan, or Wolverine.

2.9 ELECTRIC WATER COOLERS

- A. Water Fountain, wall-mounted, barrier free, chrome plated brass bubbler, front and side push-bars, stainless steel with brushed satin finish including skirt. Fountain shall comply with ANSI 117:1 and ADA for visual and motion disabilities, shall meet the requirements of ANSI/NSF 61, and the Safe Drinking Water Act.
- B. Provide filtered bottle filling unit with electronic sensor for touchless activation, built in filter monitor, and bottle counter.
- C. High efficiency, air-cooled condensing unit, capacity to cool 8.0 gallons per hour to 50 degrees F at 80 degrees F inlet water temperature and a 90 degrees F room temperature, R-134A refrigerant, and shall comply with ANSI/ARI 1010.
- D. Provide 1-1/2-inch adjustable chrome plated cast brass P traps with ground joint and cleanout plug. Tubular trap shall have a wall thickness of at least 17 gauge.
- E. Provide with steel pipe carrier for support.
- F. Manufacturer and model: Elkay LVRCTL8WSK, or equal by Halsey Taylor, Oasis, or Haws.

2.10 STAINLESS STEEL SINKS

- A. Countertop Stainless Steel Sink Product: ANSI/ASME A112.19.3, 18 gage stainless steel with integral mounting rim, minimum dimensions of 33 inches wide by 22 inches front to rear, 10" deep, double compartment with underside coated with sound dampening material. Provide top mounted ANSI/ASME A112.18.1M cast-brass single lever faucet, 8-inch swing spout with aerator, separate spray spout, and stainless-steel drain outlets with cup strainers. Provide 1-1/2 inch adjustable cast-brass P traps with cleanout plugs, ground joints, and drain piping to vertical vent stack. Tubular trap shall have a wall thickness of at least 17 gauge.
- B. Manufacturers and models of fixture: Elkay, Just, Sterling, Kohler or equal. Manufacturers and models of faucet: Commercial grade Just, Delta Teck, Chicago Faucets, Moen, Kohler, American Standard, T&S Brass, or equal. Provide angle supplies with stops, chrome plated forged brass basket strainer with 1-1/2" x 4" tailpiece, No. 8089 1-1/2" trap, and 1-2" x 6" nipple.

2.11 TERRAZZO MOP RECEPTOR

- A. Mop Receptor, ANSI/ASME A112.19.1M, terrazzo square mop receptor, minimum dimensions of 24 inches wide by 24 inches front to rear, and rim guard. Provide two single temperature, wall mounted faucets with polished chrome plated brass bodies, ANSI/ASME A112.18.1M, atmospheric vacuum breaker, 0.75-inch external hose thread male outlet, compression cartridge with spring check, key or screwdriver-controlled handle, and 1/2" female inlet. Faucets shall meet ADA ANSI/ICC A117.1

requirements. Provide 4-foot rubber hose and wall hook. Provide stainless steel rim guard for mop receptor.

- B. Manufacturer and model of fixture to be Florestone 90, or equal by Stern-Williams, or Fiat.
- C. Mop receptor faucet manufacturer and model to be T&S Brass Model B-2301 or approved commercial grade equal by Delta Teck, Stern-Williams, Fiat, American Standard, Chicago Faucets, or Kohler.

2.12 TWO COMPARTMENT UTILITY SINK

- A. Two Compartment Utility Sink Product: Unit to have two molded plastic polymer sinks, four (4) heavy duty molded legs or white baked enamel steel angle legs. Color shall be white and shall be resistant to fading and abrasion. Provide two single temperature, wall mounted faucets per basin (total of four) with polished chrome plated brass bodies, ANSI/ASME A112.18.1M, atmospheric vacuum breaker, 0.75-inch external hose thread male outlet, compression cartridge with spring check, key or screwdriver-controlled handle, and 1/2" female inlet. Faucets shall meet ADA ANSI/ICC A117.1 requirements. Provide 4-foot rubber hose and wall hook. Provide chrome plated forged brass grid strainers. Provide 1-1/2 inch adjustable cast-brass P traps with cleanout plug, ground joint, and drain piping to vertical vent stack. Tubular traps shall have a wall thickness of at least 17 gauge.
- B. Manufacturers and models of fixture: Fiat, Florestone, Stern-Williams, or equal. Manufacturers and models of faucet: T&S Brass Model B-2301 or approved commercial grade equal by Delta Teck, Stern-Williams, Fiat, American Standard, Chicago Faucets, or Kohler.

PART 3 - EXECUTION

3.1 WATER CLOSET INSTALLATION

- A. Cover supply pipe extending from wall with chrome plated sleeve and wall flange.
- B. Provide additional wall plates where each pipe extends through finished wall.
- C. Provide two rubber or plastic seat bumpers with metal holders and secure to the wainscot behind the fixture.
- D. Install centerline of the flush valve on the centerline of the fixture, and a minimum of 2-1/4 inches from the wall. Manual flush valve handles for handicap fixtures shall be mounted on the wide side of the toilet area and no more than 36 inches above the floor. All other flush valve handles shall be mounted 39 inches above the finished floor.
- E. Provide chrome-plated pipe support on the long flush pipe outlet and secure rigidly to the wall with suitable anchors.
- F. Install backflow preventer for the flush valve at the discharge of the valves.
- G. Rigidly support flush valve water piping concealed in the partition; provide piping between flush valve and wall with a factory-fabricated chromium-plated spacer sleeve and wall flange.

- H. Provide connections between soil pipes and floor connected water closets with cast-iron floor flanges. Slip floor flanges over the ends of the pipes and caulk in position. Use special short radius fittings where space does not permit the use of standard fittings below the flanges.

3.2 URINAL INSTALLATION

- A. Rigidly support flush valve and the water piping concealed in the partition. Cover supply pipe extending from wall with chrome-plated sleeve and wall flange. Provide additional wall plates where each pipe extends through finished wall.
- B. Install centerline of the flush valve for wall hung urinals on the centerline of the fixture, 45 inches above the finished floor and a minimum of 2 1/4 inches from the wall. Install centerline of the flush valve for handicap urinals 40 inches or less above the finished floor.

3.3 LAVATORY INSTALLATION

- A. Install lavatories for use by wheelchair handicapped with a rim height between 34 and 36 inches, a minimum vertical clearance of 29 inches from floor, and a minimum clear knee recess of 30 inches in width and 20 inches in depth.
- B. Install trap on lavatory for use by wheelchair handicapped so as to provide maximum clearance under bowl. Insulate exposed waste, trap and hot water supply under lavatory in accordance with the requirements for domestic hot water piping.

3.4 DRINKING FOUNTAIN INSTALLATION

- A. Mount drinking fountain so that the bubbler orifice will be 39 inches above the finished floor.
- B. Mount drinking fountain for wheelchair handicapped with a maximum bubbler orifice height of 36 inches above the floor.

3.5 SETTING COMPOUNDS AND GASKETS

- A. Provide watertight and gas tight seals between flanges and fixtures with plumbing-fixture-setting compound. In sealing connections, use neither rubber gaskets nor putty. Seal watertight all voids between the flange and the floor below the fixture with plumbing-fixture-setting compound or other approved sealing material.

3.6 OUTLET FLANGES AND ENDS OF SOIL PIPES

- A. Provide outlet flanges and ends of soil pipes set the correct distance from the face of the floor or wall to make a joint with the gasket and fixture. Obtain approval for the setting of the flange prior to setting any fixture in place.

3.7 WATER SUPPLY BRANCH PIPING

- A. Provide all exposed water supply branch piping (including valves and fittings) not more than 6 feet above the floor in toilet rooms and all piping below lavatories finished and chromium-plated.
- B. Do not bury water pipe in floor construction of any toilet room.

- C. Where water piping is not sized on the drawings, comply with the sizing requirements of the National Standard Plumbing Code.
- D. Provide each hot and cold-water supply to each service sink and lavatory with a ball or angle valve or compression stop in an accessible location near the fixture.
- E. Provide a ball valve on the connection to each wall hydrant, lawn faucet, and water cooler.
- F. Do not use stop cocks in lieu of valves.
- G. Run risers and drops supplying toilet rooms in chases, furred spaces, or shafts where possible.

3.8 FIXTURE HEIGHTS

- A. Water Closet: 17 to 19 inches to rim.
- B. Water Closet for Physically Handicapped Persons: 17 to 19 inches to top of seating surface. The flush valve handle shall be located on the "wide side" of the stall or room.
- C. Lavatory for Physically Handicapped Persons: 34 inches to rim.

3.9 SILICONE SEALANT

- A. Provide a bead of 100% white silicone sealant between the top and side edges of each water closet, urinal, service sink, lavatory, drinking fountain, and the wall to which it is adjacent.

3.10 SPARE PARTS

- A. Deliver one dozen complete sets of washers in accordance with Division 1. In each set provide one washer of each size and type used in the faucets, bibbs, ball cocks, closet tanks, flushing valves, mixing valves, and wall hydrants, installed in the project. Enclose washers in box(es) with hinged cover and a separate compartment for each size and type of washer.
- B. Provide 5 spare diaphragm kits for water closet flush valves.
- C. Provide 4 spare cartridge kits for lavatory faucets.
- D. Provide a minimum of one set of special tools required to remove vandal-proof items to the owner.
- E. These spare parts shall be turned over to the Owner within 30 days of final acceptance. The contractor shall obtain a signed receipt from the Owner which details what was turned over and the date it was turned over. A copy of this receipt shall be included in the project closeout documentation.

END OF SECTION 224000

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SECTION 224800 - WATER HEATING SYSTEMS

PART 1: GENERAL

1.1 RELATED DOCUMENTS AND RELATED WORK SPECIFIED ELSEWHERE:

- A. Drawings, Standard General Conditions of the Construction Contract, including Supplementary General Conditions, Division 01 Specification sections, other Division 22 specification sections, Division 23, and Division 26 specifications apply to work of this section.
- B. Section 220110 - Plumbing General Requirements
- C. Section 220150 - Basic Materials and Methods
- D. Section 220700 - Plumbing Insulation
- E. Section 224000 - Plumbing Fixtures

1.2 SUBMITTALS

- F. Submit under provisions of Division 01, and Division 22, "Plumbing General Requirements" the following: manufacturer's catalog data, installation, dimensions (including rough in dimensions) and operating and maintenance data for plumbing specialty items; catalog data and material certification for pipe materials and fittings. Provide for all items as listed in Specification Section 220110.

1.3 QUALITY ASSURANCE

- G. Equipment of the same general type shall be of the same make.
- H. Brand names and catalog numbers included with equipment or material specifications are used to indicate quality, rating or operating characteristics of the equipment or material.
- I. Gas water heaters shall be third party certified and NSF approved.
- J. All materials provided shall be new and shall be approved by the Underwriter's Laboratories, Inc. wherever that agency has applicable standards. All work shall be accomplished in a neat, workmanlike manner by experienced journeymen. All work shall be performed at such times as are required by the progress of the job.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years' experience.
- B. Installer: NC State licensed plumber specializing in performing the work of this section with minimum 3 years' experience.

1.5 REGULATORY REQUIREMENTS

- A. Installation and materials shall be in conformance with the North Carolina State Building Code latest edition (International Plumbing Code as modified and adopted by the North Carolina Building Code Council).

1.6 DELIVERY, STORAGE, AND HANDLING

- B. Deliver, store, protect and handle products to site under provisions of Division 01 and Division 220110, Plumbing General Requirements.

1.7 SYSTEM COMPLETION

- C. Provide all bolts, nuts, gaskets, sleeves, hangers, supports, miscellaneous valves and fittings, and specialties required for complete installation of the piping and equipment to be provided.

PART 2: PRODUCTS

2.1 COMMERCIAL POINT-OF-USE ELECTRIC WATER HEATER (SMALL TANK)

- A. Automatic, electrically heated, high thermal efficiency water heater shall be provided where indicated on the drawings. Water heater shall meet or exceed the energy factor requirements of ASHRAE.
- B. The water heater shall be a model with a rated storage capacity of not less than 10 gallons, electrical input of 6000 W at 208V, single phase power, and a minimum recovery of 24 GPH at a 100°F rise.
- C. The tank interior shall be coated with a high temperature porcelain enamel or be glass lined. The tank shall have a magnesium anode rod rigidly supported. The tank shall have a working pressure rating of 150 psi and be insulated with rigid polyurethane foam insulation.
- D. The heater shall have the UL seal of certification and come equipped with a CSA/ASME rated T&P relief valve.
- E. Electric heating elements shall be copper, resistored, screw-in type. Water heater will be equipped with a surface mounted thermostat, with an integral, manual reset, high limit control.
- F. Provide with 3-year limited tank warranty.
- G. Manufacturers: Ruud EGSP10, or approved equal by A.O. Smith, Bradford White, American, Rheem, or State.

2.2 EXPANSION TANK

- A. Provide an expansion tank with minimum acceptance volume of 1.0 gallon, IAPMO listed and ANSI/NSF 61 certified, lead free, rated for a maximum pressure of 80 psi (10 bar), by Zurn Wilkins, Watts, Amtrol, or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

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

B. Pipe relief full size from water heaters to nearest drain.

END OF SECTION 224800

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SECTION 230510 - BASIC MECHANICAL REQUIREMENTS

PART 1: GENERAL

1.1 RELATED DOCUMENTS AND RELATED WORK SPECIFIED ELSEWHERE:

A. Related Documents

1. Drawings, Standard General Conditions of the Construction Contract, including Supplementary General Conditions, Division-01 Specification sections and other Division 23 specification sections and Division 26 specifications apply to work of this section.

1.2 REFERENCES & INTENT

- A. All work of this Division shall comply with the requirements of the Drawings, General Conditions, Supplementary General Conditions and Division 01 Specifications section.
- B. Study all drawings and specifications before submitting bids.
- C. Work under this Division includes all essential labor, materials, tools, equipment, transportation, insurance, temporary protection, supervision and incidental items for proper installation and operation of all systems even though not specifically mentioned or indicated.
- D. Drawings are diagrammatic. Drawings are not intended to be absolutely precise and do not specify or show every offset, fitting, and component. The purpose of the drawings is to indicate a system concept, the main components of the systems, and the approximate geometrical relationships. Based on the systems concept, the main components, and the approximate geometrical relationships, the contractor shall provide all other components and materials necessary to make the systems fully complete and operational. Contractor shall route piping or provide offsets to avoid interference with structural elements, equipment, electrical panels and junction boxes, etc. Verify locations, dimensions, flow directions, etc. before construction.
- E. It is the intent of these specifications and drawings to provide for finished systems of the quality specified, properly tested, balanced and ready for operation. This includes all devices and accessories required to make the work complete even though such items may not be expressly shown or specified. Drawings and specifications are complementary and must be so construed to determine the full scope of work.
- F. Jobsite Conditions. The Contractor shall visit the site and familiarize himself with the existing conditions before submitting his bid. Failure to do so does not relieve the Contractor from completing the work as specified herein and after. Requests for additional payments due to the Contractor's failure to allow for work conditions will be rejected.

1.3 WORK INCLUDED

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

2. All associated wiring, cutting and patching.
 3. The building mechanical systems for this project will be commissioned by a commissioning agent. The contractor shall provide all material and resources necessary to ensure compliance with the requirements of specification section 01 91 13 – general commissioning requirements, and with the requirements of the commissioning plan.
- B. Bidders shall examine equipment plans and specifications and include in their bids all labor and material required for complete installation and connection of equipment which is properly a part of their trade even if it is not provided in the equipment specifications.

1.4 STANDARDS AND CODES

- A. All equipment with electrical components shall bear the UL label.
- B. Standards by the following organizations shall be complied with wherever applicable:
1. ANSI American National Standards
 2. ASHRAE American Society of Heating, Refrigerating and Air-Conditioning Engineers
 3. ASTM American Society for Testing Material
 4. NEC National Electric Code
 5. NEMA National Electrical Manufacturers Association
 6. NFPA National Fire Protection Association
 7. OSHA Occupational Safety and Health Act
 8. SMACNA Sheet Metal and Air Conditioning Contractors National Association, Inc.
 9. North Carolina State Building Code - 2018
 10. Any Other Applicable local and State Codes
- C. In the event, there are conflicts between specifications and standards or codes, standards or codes shall govern unless specifications are in excess of standards.

1.5 PERMITS AND FEE

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

1.6 STRUCTURAL STEEL AND CONCRETE

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

1.7 WATERPROOFING

- A. Waterproofed floors and walls may not be cut.

1.8 WORK SCHEDULE:

- A. Work schedule shall be in accordance with Division 01.
- B. Any demolition or installation work producing excessive dust or noise deemed to be disruptive or possibly unsafe to building operations must be, at the Owner's discretion, performed after normal working hours.

1.9 PROTECTION OF EQUIPMENT

- A. Provide all necessary protection and be fully responsible for material and equipment stored or installed on the site. Material or equipment stolen or damaged shall be replaced at no additional cost to the Owner.
- B. Provide protection against theft, physical damage and the entry of dirt, water or corrosive fumes into the material and equipment. Maintain protective covers for the duration of construction. Store equipment, such as controls, subject to damage by moisture and temperature extremes in a dry, heated space.

1.10 FIRE SAFETY

- A. Fire Watch: Provide a fire watch wherever welding, brazing, cutting or other processes involving an open flame or potential for generating sparks is used. Fire watch shall consist of a person with a 10-pound carbon dioxide fire extinguisher. While on fire watch, the person so assigned shall have no other duties or assignments.
- B. Fire Blanket: In addition to providing a fire watch, use an approved fire blanket to cover any combustible materials in the immediate area.
- C. Burn Permit: For all cutting, burning and welding operations a burn permit is required. This permit may be obtained from the University at no cost.

1.11 GUARANTEES

- A. Furnish written guarantee in accordance with requirements of General Conditions. Partial approval of a portion of work does not affect the validity of guarantee.

1.12 SHOP DRAWINGS

- A. It shall be noted that shop drawing submittals processed by the Engineer are not change orders; that the purpose of shop drawing submittals is to demonstrate to the Engineer that the Contractor understands the design concept, that he demonstrates his understanding by indicating which equipment and material he intends to furnish and install, and by detailing the fabrication and installation methods he intends to use. If deviations, discrepancies or conflicts between shop drawing submittals and the contract documents in the form of design drawing and specifications are discovered either prior to or after shop drawing submittals are processed by the Engineer, the design drawings and specifications shall control and shall be followed. The Engineer may also require the contractor to submit samples of proposed or specified equipment for approval with the samples to be returned to the contractor upon request. During the submittal process, if the contractor submits equipment which is not EXACTLY like the equipment specified, the contractor shall provide a list of those differences to the engineer for his review and approval. If the contractor's list is incomplete, and the submittal is approved, the approval does not waive the differences that were not submitted for review.
- B. Prior to procurement or manufacturing, submit for approval appropriate shop drawings and/or descriptive literature giving performance data, physical size, wiring diagrams, configuration, capacity, material, etc., for all items under this Division including the following:
 - 1. Supports, Anchors, and Vibration Isolation
 - 2. Adjustable Speed Drives
 - 3. Painting and Identification

4. Testing and Balancing
 5. Insulation
 6. Controls & Instrumentation
 7. Refrigerant Piping and Specialties
 8. Ductwork and Dampers
 9. Power Ventilators
 10. Air Outlets and Inlets
 11. Packaged Heat Pump Rooftop Units
 12. Split System Air Cooled Heat Pumps
 13. Ductless Split System Air Cooled Heat Pumps
 14. Electric Unit Heaters
- C. The contractor shall visit the site and familiarize himself with the project requirements and the field conditions before preparing shop drawings and ordering equipment. Field verify the characteristics of all specified or existing equipment before preparing shop drawings. This shall include available space, available voltages, suitability of substrate for receiving the specified equipment, etc. Where existing equipment is re-used, he shall verify dimensions, capacities, horse-power, etc. and bring any discrepancies to the attention of the Engineer.
- D. Where different products have to work together, it is the Contractor's responsibility to select manufacturers whose products are visually and/or technically compatible.
- E. Prepare listing of all equipment and materials for the project. A sample schedule is included at the end of this section to complete this requirement. Provide all information represented.
- F. Submittals of shop drawings and manufacturer's data, etc. shall be provided to the Designers electronically in PDF format. The Designer will review the submittals and return them electronically. The exception would be color samples or other material that cannot be adequately represented electronically, and these should be submitted as five (5) hard copies. The Designer will review them and return three (3) copies.
- 1.13 RECORD DRAWINGS
- A. During construction, keep an accurate record of all changes and deviations from contract documents. Upon completion of this installation, the contractor shall submit to the Engineer colored scans of the marked-up prints in PDF format indicating any installed work that is different from what is shown on the drawings.
- B. These record drawings shall include detailed locations and depths for all below slab pipes.

PART 2: PRODUCTS

2.1 QUALITY OF MATERIAL

- A. Equipment of the same general type shall be of the same make. Reference is made to relays, motors, valves, motor starters, contactors, etc.
- B. Brand names and catalog numbers included with equipment or material specifications are used to indicate quality, rating or operating characteristics of the equipment or material.

- C. All materials provided shall be new and shall be approved and labeled by the Underwriter's Laboratories, Inc., or other accredited third-party agency, wherever such agency has applicable standards. All work shall be accomplished in a neat, workmanlike manner by experienced journeymen. All work shall be performed at such times as are required by the progress of the job.
- D. All components, equipment and systems shall comply with the latest edition adopted by the State of North Carolina ASHRAE 90.1, ASHRAE 62.1, ASHRAE 15 and any other applicable ASHRAE standard.

PART 3: EXECUTION

3.1 RATED ASSEMBLIES

- A. Installation of any equipment shall not compromise fire ratings of rated assemblies. All penetrations shall be sealed per UL guidelines for penetration protections. Provide fire dampers where required by code.

3.2 CLEARANCE AND RESTORATION OF SITE

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

3.3 COORDINATION

- A. Install all work to permit removal of equipment without damage to the equipment or the building. Verify equipment space requirements, condition of substrate, voltages, etc. at the time of shop drawing submission and advise the Engineer of any conflict.
- B. Coordinate equipment locations as well as piping and conduit routing with Owner's representative to optimize all present and foreseen future space usage and clearance requirements.
- C. Do not rough prior to receipt of approved shop drawings.

3.4 EQUIPMENT INSTALLATION AND SUPPORT

- A. Install all equipment where indicated, in accordance with manufacturer's published installation instructions, and with recognized industry practices to ensure that equipment complies with requirements and serves intended purposes. Consult with Engineer if said instructions or practices conflict with the drawings/specifications.
- B. The manufacturer's installation instructions shall be available on the job site at the time of inspection and start-up as required by NC Mechanical Code 304.1.
- C. Support plumb, rigid and true to line all work and equipment furnished under this Division. Study thoroughly architectural, mechanical drawings and all related drawings to determine how equipment, piping, ductwork, etc., are to be supported, mounted or suspended. Provide extra steel bolts, inserts,

pipe stands, brackets and accessories for proper support as required whether or not shown on drawings. When directed, furnish for approval a drawing showing supports.

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

3.5 FINAL ADJUSTMENT AND TESTING

- A. General - Provide all testing, preliminary and final adjustment of instrumentation for this purpose. Conduct all tests in full compliance with applicable codes prior to covering or concealing work by insulation, enclosures, etc. Material found to be defective shall not be repaired. It shall be replaced with new material which tests satisfactorily. Defective workmanship shall be corrected.
- B. Working Tests - Subject all equipment and controls to simultaneous and continuous working tests for a period of one day prior to final inspection. Make adjustments, repairs and equipment replacements as required.

3.6 LABELS, IDENTIFICATION AND TAGS

- A. All components or equipment shall be identified using permanent engraved nameplates, permanently attached with pin-head screws to device or to wall or mounting panel above device. Stick-on type labels will not be acceptable.
- B. Label and identify all piping installed under this contract. Install plastic pipe markers or stenciling after finish painting has been completed.
- C. Refer to Section 23 05 90 – Mechanical Painting and Identification.

3.7 OWNER'S RIGHT TO TEST SYSTEMS

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

3.8 CLEANING UP

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

3.9 INSPECTION CERTIFICATES

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

3.10 DESIGNER INSPECTIONS

- A. The designer will make regular site visits during construction and will keep a deficiency log of all observed exceptions. The contractor shall resolve these noted deficiencies as expediently as possible.

3.11 FINAL REVIEW

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

3.12 EQUIPMENT DELIVERY AND PROTECTION

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

3.13 MAINTENANCE MANUALS

- A. O&M documentation shall be delivered within 60 days of the Contractor receiving approved shop drawings.
- B. Maintenance Manuals shall be submitted in three (3) copies in vinyl 3-ring binders, plus (3) copies in pdf format on disks. Each binder shall have the following:
 - 1. Service telephone number of the installing company, including an emergency number.
 - 2. Maintenance and emergency repair contact information shall be provided for all equipment both in the manual and on labels to be placed on an easily visible location on equipment.
 - 3. Contact person, phone number, and address of manufacturer or distributor where equipment was purchased.
 - 4. The manufacturing company's operating and maintenance manuals for each piece of equipment.
 - 5. Consolidated list of maintenance procedures and maintenance / spare parts recommended by the equipment manufacturers. The spare parts list shall give the correct manufacturer, model / part number, correct size and recommended quantities of spares.
 - 6. Copies of all approved shop drawings.
 - 7. Copies of warranties with their start dates.
- C. Furnish for each building permanent type charts, framed under clear plastic, mounted in at least one mechanical room on each floor or where directed as follows:
 - 1. Service organizations with day and night telephone numbers.

3.14 OPERATING INSTRUCTIONS

- A. The Contractor shall provide a minimum of eight (8) hours of personal instruction to Owner's personnel in the proper operation of all equipment specified and provided. The instruction shall be provided by factory trained and certified competent personnel.

- B. If off-site instruction is required, the contractor shall include in his bid the cost of boarding, lodging and transportation of three people from Greensboro to the training site. The cost shall also include all costs during the training period.

PRODUCTS LISTING FORM**INSTRUCTIONS:**

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

Prepared by: _____

Date: _____ Project: _____

<u>SPEC. SECTION</u>	<u>ITEM</u>	<u>MANUFACTURER</u>

END OF SECTION 230510

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SECTION 230529 - SUPPORTS, ANCHORS AND VIBRATION ISOLATION

PART 1: GENERAL

1.1 RELATED DOCUMENTS AND RELATED WORK SPECIFIED ELSEWHERE:

A. Related Documents

1. Drawings, Standard General Conditions of the Construction Contract, including Supplementary General Conditions, Division-01 Specification sections and other Division 23 specification sections.

1.2 QUALITY ASSURANCE:

A. Codes and Standards:

1. Code Compliance: Comply with applicable codes pertaining to product materials and installation of supports and anchors.
2. UL and FM Compliance: Provide products which are UL-listed and FM approved where required.
3. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS) Standard Compliance:
 - a. Provide pipe hangers and supports of which materials, design, and manufacture comply with MSS SP-58.
 - b. Select and apply pipe hangers and supports, complying with MSS SP-69.
 - c. Fabricate and install pipe hangers and supports, complying with MSS SP-89.
 - d. Terminology used in this section is defined in MSS SP-90.
 - e. Acceptable Manufacturers: Vibration Mountings and Controls, Inc., Grinnell, Modern, Mason Industries, Metraflex, or approved equal.

1.3 SUBMITTALS:

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

PART 2: PRODUCTS

2.1 HORIZONTAL-PIPING HANGERS AND SUPPORTS:

- A. General: Except as otherwise indicated, provide factory- fabricated horizontal-piping hangers and supports complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide galvanized hangers, rods, support assemblies, connectors, etc., except provide copper-plated hangers and supports for copper-piping systems.

- B. Adjustable Steel Clevis Hangers: MSS Type 1.
- C. Yoke Type Pipe Clamps: MSS Type 2.
- D. Steel Double Bolt Pipe Clamps: MSS Type 3.
- E. Steel Pipe Clamps: MSS Type 4.
- F. Adjustable Swivel Pipe Rings: MSS Type 6.
- G. Adjustable Steel Band Hangers: MSS Type 7.
- H. Adjustable Band Hangers: MSS Type 9.
- I. Adjustable Swivel Rings, Band Type: MSS Type 10.
- J. Split Pipe Rings: MSS Type 11.
- K. Extension Split Pipe Clamps: MSS Type 12.
- L. U-Bolts: MSS Type 24.
- M. Clips: MSS Type 26.
- N. Pipe Slides and Slide Plates: MSS Type 35, including one of the following plate types:
 - 1. Plate: Unguided type.
 - 2. Plate: Guided type.
 - 3. Plate: Hold-down clamp type.
- O. Pipe Saddle Supports: MSS Type 36, including steel pipe base- support and cast-iron floor flange.
- P. Pipe Stanchion Saddles: MSS Type 37, including steel pipe base support and cast-iron floor flange.
- Q. Adjustable Pipe Saddle Supports: MSS Type 38, including steel pipe base support and cast-iron floor flange.
- R. Single Pipe Rolls: MSS Type 41.
- S. Adjustable Roller Hangers: MSS Type 43.
- T. Pipe Roll Stands: MSS Type 44.
- U. Adjustable Pipe Roll Stands: MSS Type 46.

2.2 VERTICAL-PIPING CLAMPS:

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

B. Two-Bolt Riser Clamps: MSS Type 8.

C. Four-Bolt Riser Clamps: MSS Type 42.

2.3 HANGER-RODS AND ATTACHMENTS:

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

B. Steel Turnbuckles: MSS Type 13.

C. Swivel Turnbuckles: MSS Type 15.

D. Malleable Iron Sockets: MSS Type 16.

2.4 BUILDING ATTACHMENTS:

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

B. Concrete Inserts: MSS Type 18.

C. Rod Attachment Concrete Plate

D. Channel Clamps: MSS Type 20.

E. Welded Beam Attachments: MSS Type 22.

F. C-Clamps: MSS Type 23.

2.5 SADDLES AND SHIELDS:

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

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

2.6 MISCELLANEOUS MATERIALS:

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

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

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

2.7 VIBRATION ISOLATION:

- A. General: Provide vibration isolation where indicated in the plans. Equipment isolation shall be as designed and submitted by the equipment manufacturer.
- B. Equipment shall be isolated from the structure by means of resilient vibration and noise isolating supports. Supports shall be such that vibration is isolated and expansion and contraction is accommodated without creating excessive stresses in piping or equipment connections.
 - 1. All isolators shall be designed or treated for resistance to corrosion. Steel components shall be PVC coated, or phosphated and painted with industrial grade enamel. All nuts, bolts and washers shall be zinc-electroplated. Structural steel bases shall be thoroughly cleaned of welding slag and primed with zinc chromate or metal etching primer. A finish coat of industrial enamel shall be applied over the primer. All isolators exposed to the weather shall have steel parts PVC coated, hot-dipped galvanized or zinc-electroplated plus coating of neoprene or bitumastic paint. Aluminum components for outdoor installation shall be etched and painted with industrial grade enamel. Nuts, bolts and washers may be zinc-electroplated.
 - 2. Isolators shall be installed in such a manner that loaded deflections are compensated for initially.
- C. Vibration bases and/or isolators shall be provided for motors and motor-driven equipment, where indicated on the drawings.
- D. Isolator Elements: Steel springs shall be open or housed type as specified with static deflection required and the capability of 30% over travel before becoming solid. Springs shall be designed for lateral stability with a stiffness ratio of 1 except where greater horizontal thrust required greater horizontal stiffness.
- E. Elastomers shall be rubber, neoprene, Buna N, silicone or other material to meet specific service conditions and shall be molded in the range of 30 to 60 durometers. Material shall be of color coded stock for easy identification of rated load capacity.
- F. Pre-compressed fiber glass shall consist of a high-density matrix of molded glass fiber encased in a waterproof neoprene jacket resistant to oil, acids and fungus and color coded for easy identification of rated load capacity.
- G. Isolator Types: Isolators shall be applied in accordance with the "types", as follows, where Type I isolators shall be utilized for centrifugal refrigeration machines installed on or below grade; Type II isolators shall be utilized with mounted equipment of 3 HP or less (unless otherwise specified); Type III isolators shall be utilized with mounted equipment of 5 HP or larger (unless otherwise specified); and Type IV isolators shall be utilized for all suspended pipe and equipment:
 - 1. Type I - Pad type mountings consisting of any one of the following constructions:
 - a. Two layers of ribbed or waffled neoprene pads bonded to a 16-gauge galvanized steel separator plate. Bolting not required. Pads shall be sized for approximately 20 to 40 psi load, or a deflection of 0.12 inch to 0.16 inch.

- b. Pre-compressed fiberglass properly sized for 5 to 60 psi loading depending on density with steel plates bonded to top of isolator.
 - c. Two layers of ribbed or waffled neoprene pads bonded to vibration cork sized for 10 to 60 psi loading.
 - 2. Type II - Elastomeric mountings having steel baseplate with mounting holes and a threaded insert at top of the mounting for attaching equipment. All metal parts shall be completely embedded in the elastomeric material. Mountings shall be designed for approximately 1/4-inch deflection and loaded so that deflection does not exceed 15% of the free height of the mounting.
 - 3. Type III - Adjustable, freestanding, open-spring mountings with combination leveling bolt and equipment fastening bolt. Spring (or springs) shall be rigidly attached to mounting base plate and to the spring compression plate. A neoprene pad having a minimum thickness of 1/4 inch shall be bonded to the baseplate.
 - 4. Type IV - Spring hangers for isolation of noise and vibration consisting of a rectangular steel box, elastomeric element, coil spring, spring cups, neoprene impregnated fabric washer, and steel washer. The design shall be such as to prevent metal-to-metal contact between the hanger rod and the top of the hanger box. The elastomeric element shall meet the design requirements for Type II mountings. The hanger box shall be capable of supporting a load of 200% of rated load without noticeable deformation or failure. For piping, provide combination spring and double deflection low dynamic stiffness hangers, same or equal to Mason Industries 30N.
- H. Piping Isolation: Flexible connectors in piping at equipment mounted on vibration isolators shall allow for movement between pipe and equipment. Flexible connectors shall have flanged or screwed ends to match pipe size of line. If screwed ends are used, flanges or unions must be installed to allow for removal of units.
- 1. Rubber Construction: Single sphere neoprene rubber, large change in diameter, consisting of multiple plies of Kevlar tire cord and EPDM, rated at 225 internal pressure, with captive flanged connections. Provide as manufactured by Keflex, Metraflex, or Mason Industries.
 - 2. Stainless Steel Construction and shall be as made by Keflex or equivalent by Flex Hose or Minnesota Flex. Units shall be designed for no less than 125 psi pressure and have a maximum operating temperature of 450 degrees F. Each unit shall be of the proper length to accept the movement involved and be fitted with a braided jacket.
- I. Duct Isolation: Flexible EPDM connectors between duct at equipment mounted on vibration isolators shall allow for movement between duct and equipment. Flexible connectors shall be weather sealed with gasketed ends to make connection to unit flange and duct.

PART 3: EXECUTION

3.1 INSTALLATION OF HANGERS AND SUPPORTS:

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

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

- B. Provide all fascia boards, cleats, brackets, backing in partitions, toggle bolts, expansion shields, screws, clamps and rods, etc., for hanging of all piping and equipment included under this Division.
- C. Hangers and braces shall adequately support the piping system horizontally and vertically and shall allow for expansion and contraction without binding in sleeves or misalignment. Provide for expansion of piping with swing joints and ample sleeves.
- D. Vertical Piping: Supports for vertical piping 1-1/2 inches and smaller from wall with malleable split ring hanger. Nipples cut to fit each case. Two hangers per floor minimum. Use clamps on every floor for pipes 2 inches and larger. In crawl spaces, support stacks on base fitting placed securely on concrete piers or masonry blocks and with pipe clamps.
- E. Horizontal piping shall be supported with hangers as follows:

STEEL PIPE SIZE	ROD DIAMETER	MAXIMUM SPACING
Up to 1 inch	3/8 inch	7 feet
1-1/4" inches	3/8 inch	8 feet
1-1/2 inches	3/8 inch	9 feet
2 inches	3/8 inch	10 feet
2-1/2 inches	1/2 inch	11 feet
3 inches. & 3-1/2 inches.	1/2 inch	12 feet
4 inches and 5 inches	5/8 inch	14 feet
6 inches	7/8 inch	17 feet
8 inches	7/8 inch	19 feet
10 inches	7/8 inch	20 feet
12 inches	7/8 inch	23 feet

COPPER TUBE SIZE	ROD DIAMETER	MAXIMUM SPACING
1/2 & 3/4 inch	3/8 inch	5 feet
1 inch	3/8 inch	6 feet
1-1/4 inch	3/8 inch	7 feet
1-1/2 inches	3/8 inch	8 feet
2 inches	3/8 inch	8 feet
2-1/2 inches	1/2 inch	9 feet
3 inches & 4 inches	1/2 inch	10 feet

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

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

- G. Generally, pipes shall be individually supported. Trapeze hangers may be used where approved. Piping shall be individually bolted to trapeze with U bolts.
- H. Piping Along Wall - From approved wall brackets fastened to wall with Phillips anchors or inserts. Installation - Provide pipe bars, angles, etc. as required. Anchor piping to localize expansion and

prevent undue strain on piping and branches. Provide spring type hangers for vibration isolation where shown on plans and as specified in vibration isolation section.

- I. Locate hanger not more than 4 feet from elbow or tee on screwed piping. Space hangers on 3-foot center on horizontal piping 1-1/2 inch and smaller exposed at corridor ceilings and less than 8 feet from floor in finished rooms.
- J. Support from Concrete Construction - All main piping runs shall be supported from hangers secured to cast-in-place concrete inserts. Branch piping hanger supports may be field drilled using self-drilling type expansion shields equal to Phillips concrete fasteners or approved equal. Expansion shields shall not cut or unduly displace reinforcement.
- K. Support from Precast Concrete - Use toggle bolts mounted in core sections of precast concrete. Absolutely no ramset or any other power-driven fasteners will be allowed in precast planks.
- L. Support from Existing Concrete - Piping may be attached to the structure using power driven fasteners. All fasteners into concrete shall penetrate the slab for a distance equal to 6 to 8 times the diameter of the shank. Power driven fasteners will not be used in concrete encased steel beams.
- M. Test drill existing concrete to ensure rebar is not cut or damaged when installing anchors.
- N. Support from Structural Steel - Make use of existing steel members for pipe support. Provide additional structural steel members where required to accommodate hangers.
- O. Anchors - Anchor piping as shown or required to isolate expansion and prevent pipe strain due to expansion. Anchors shall be separate from other supports.
- P. Expansion Joints and Pipe Guides – Install in accordance with manufacturers recommendation. Locate additional guide within recommended distance of the first guide integral to the expansion joint.
- Q. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.
- R. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.

3.2 PROVISIONS FOR MOVEMENT:

- A. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.
- B. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

3.3 PIPE EXPANSION:

- A. Insulated Piping: Comply with the following installation requirements.

1. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.
2. Shields: Where low-compressive-strength insulation or vapor barriers are indicated on cold or chilled water piping, install coated protective shields.

3.4 EQUIPMENT SUPPORTS:

- A. Provide concrete housekeeping bases for all floor-mounted equipment furnished as part of the work of Division 23. Unless otherwise noted, size bases to extend minimum of 4" beyond equipment base in any direction; and 4" above finished floor elevation. Construct of reinforced concrete, roughen floor slab beneath base for bond, and provide steel rod anchors between floor and base. Locate anchor bolts using equipment manufacturer's templates. Chamfer top and edge corners. Provide concrete bases and pads where required in compliance with section 23 05 45 of these specifications.
- B. Provide structural steel Stands to support equipment not floor mounted or hung from structure. Construct of structural steel members or steel pipe and fittings. Provide shop drawings for structural steel stands for Engineer's approval.

3.5 GALVANIZING:

- A. All hangers, supports, and connections shall be galvanized coated.

END OF SECTION 230529

SECTION 230530 - ELECTRICAL PROVISIONS FOR MECHANICAL WORK

PART 1: GENERAL

1.1 RELATED DOCUMENTS AND RELATED WORK SPECIFIED ELSEWHERE:

A. Related Documents

1. Drawings, Standard General Conditions of the Construction Contract, including Supplementary General Conditions, Division-01 Specification sections, other Division 23 specification sections, and Division 26 specifications apply to work of this section.

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

1.2 DESCRIPTION OF WORK

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

- B. Types of work, normally recognized as electrical, but provided as mechanical, specified or partially specified in this section, include but are not necessarily limited to the following:

1. Unless otherwise noted, the mechanical contractor shall provide all motors for mechanical equipment.
2. Unless otherwise noted, the mechanical contractor shall provide all motor starters, and combination starters/disconnects required for mechanical equipment, whether or not these are specifically indicated to be furnished with the mechanical equipment. Motors being equipped with adjustable speed drives (ASD's) will not require starters. The contractor will provide the ASD's.
3. All interlock and control wiring required for sequence of operation of mechanical devices provided for mechanical systems.
4. All power wiring for mechanical equipment and all power and low voltage wiring for the DDC controls.
5. Any power wiring required for mechanical equipment not specifically shown on electrical drawings or specified in Division 26.

1.3 DIVISION OF WORK

- A. This section delineates the division of work between Divisions 23 and Division 26. Specific work to be done under Division 26 is hereinafter listed or described. All other work necessary for the operation of Division 23 equipment shall be performed under Division 23.

1. All individual motor starters and drives for mechanical equipment (fans, pumps, etc.) shall be furnished and installed under Division 23 unless indicated as a part of a motor control center. Motor starters for mechanical equipment provided in motor control centers shall be furnished under Division 26.
2. Under Division 26, power wiring shall be provided up to a termination point consisting of a junction box, trough, starter, ASD or disconnect switch. Under Division 26-line side

terminations shall be provided. Wiring from the termination point to the mechanical equipment, including final connections, shall be provided under Division 23.

3. Equipment less than 110Volt, all relays, actuators, timers, seven-day clocks, alternators, pressure, vacuum, float, flow, pneumatic-electric, and electric-pneumatic switches, aquastats, freezestats, line and low voltage thermostats, thermals, remote selector switches, remote push-button stations, emergency break-glass stations, interlocking, disconnect switches beyond termination point, and other appurtenances associated with equipment under Division 23 shall be furnished, installed and wired under Division 23.
4. All wiring required for controls and instrumentation not indicated on the drawings shall be furnished and installed by Division 23.
5. Roof exhaust fans with built-in disconnects provided under Division 23, or doors provided with built-in outlets shall be wired under Division 26 to the line side of the disconnect switch, or the outlet. A disconnect switch shall be provided under Division 26 if the fan is not provided with a built-in disconnect switch. In this case wiring from the switch to the fan shall be under Division 23.
6. The sequence of control for all equipment shall be as indicated on the Division 23 Drawings.
7. Provide combination starter disconnects in lieu of individual starter and disconnect switch.
8. A diagram clarifying who is to provide and install the termination point including but not limited to the following: trough, ASD, individual starter, disconnect switch, Junction Box is part of the electrical detail sheets. This detail is also included on Sheet M1.1.
9. Conduits and wires specifications for other sections/divisions reference the wires and conduit specifications in Section 26.
10. Disconnects for the elevator and the elevator's car shall be provided and installed by the electrical contractor.
11. Sizing of circuit breakers and feeders in the design documents is selected per the basis of design equipment such as elevator, kitchen and mechanical equipment. It is the electrical contractor's responsibility to coordinate the wire, raceway and feeding circuit breaker sizes required for all equipment with the contractor providing the equipment.

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

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

1.4 QUALITY ASSURANCE:

A. Coordination with Electrical Work: Wherever possible, match elements of electrical provisions of mechanical work with similar elements of electrical work specified in Division-26 sections. Comply with applicable requirements of Division-26 sections for electrical work of this section which is not otherwise specified.

B. Standards: For electrical equipment and products, comply with applicable NEMA standards, and refer to NEMA standards for definitions of terminology herein. Comply with National Electrical Code (NFPA 70) for workmanship and installation requirements. Electrical work shall be done in accordance with Codes listed and also requirements of Division 26.

1.5 SUBMITTALS:

A. Listing, Motors of Mechanical Work: Concurrently with submittal of mechanical products listing (Basic Mechanical requirements), submit separate listing showing rating, power characteristics,

application (connected equipment), and general location of every motor to be provided with mechanical work. Submit updated information promptly when and if initial data is revised.

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

PART 2: PRODUCTS

2.1 MOTORS:

- A. Manufacturer: Except where item of mechanical equipment (which otherwise complies with requirements) must be integrally equipped with motor produced by another manufacturer, provide motors for mechanical equipment manufactured by one of the following:
 - 1. Baldor Electric Co.
 - 2. General Electric Co.
 - 3. Reliance Electric Co.
 - 4. Westinghouse Electric Corp.
 - 5. U.S. Electric Motor Co.
- B. Motor Characteristics: Except where more stringent requirements are indicated, and except where required mechanical equipment cannot be obtained with fully complying motor, comply with the following requirements for motors of mechanical work:
- C. Temperature Rating: Rated for 40 deg.C environment with maximum 50 deg.C temperature rise for continuous duty at full load. Insulation shall be Class F.
- D. Starting Capability: Provide each motor capable of making starts as frequently as necessary by automatic control system, and not less than 5 starts per hour for manually controlled motors.
- E. Phases and Current Characteristics: Unless otherwise noted, provide squirrel-cage induction polyphase motors for 2 hp and larger, and provide capacitor-start single-phase motors for 1/3 hp and smaller, except 1/6 hp and smaller may, at equipment manufacturer's option, be split-phase type. Coordinate current characteristics with power specified in Division-16 sections, and with individual equipment requirements specified in other Division-15 requirements. For 2-speed motors provide 2 separate windings on polyphase motors. Unless otherwise noted all polyphase motors shall be suitable for 240 volts, 3 phase, 60 Hz service.
- F. Service Factor: 1.15 for polyphase motors and 1.35 for single-phase motors.
- G. Motor Construction: Provide general purpose, continuous duty motors, Design "B" except "C" where required for high starting torque. For motors controlled by variable speed drives, provide inverter duty motors that comply with NEMA MG1-Part 3 Definite Purpose Inverter-Fed Motors.
- H. Frames: NEMA No. 56 or Type T (unless otherwise noted)
- I. Bearings: Ball or roller bearings with inner and outer shaft seals, re-greaseable except permanently sealed where motor is normally inaccessible for regular maintenance.

- J. Where belt drives and other drives produce lateral or axial thrust, in motor, provide bearings designed to resist thrust loading. Refer to individual sections of Division 23 for fractional-hp light-duty motors where sleeve-type bearings are permitted.
- K. Enclosure Type: Except as otherwise indicated, provide TEFC motors. Refer to individual sections of Division 23 for other enclosure requirements.
- L. Overload Protection: Provide built-in thermal overload protection and, where indicated, provide internal sensing device suitable for signaling and stopping motor at starter.
- M. Noise Rating: Provide "Quiet" rating on motors.
- N. Efficiency: All permanently wired motors of 1 HP or more shall be premium efficiency motors which have a nominal full load motor efficiency not less than that required by ASHRAE 90.1-2010.
- O. Name Plate: Provide metal nameplate on each motor, indicating full identification of manufacturer, ratings, characteristics, construction, special features and similar information.

2.2 EQUIPMENT FABRICATION:

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

2.3 MOTOR STARTERS:

- A. Manufacturers: Subject to compliance with requirements, provide motor starters of one of the following (for each type and rating of motor starter):
 - 1. Allen-Bradley Co.
 - 2. Cutler Hammer Products, Eaton Corp.
 - 3. General Electric Co.
 - 4. Square D Co.
 - 5. Westinghouse Corp.
- B. General: Except as otherwise indicated, provide motor starters and ancillary components which comply with manufacturer's standard materials, design and construction in accordance with published product information, and as required for complete installation.
- C. Type and size of starter shall be as recommended by motor manufacturer and the driven equipment manufacturer for applicable protection and start-up condition.
- D. Motor Starter Characteristics:
 - 1. Enclosures: NEMA 1, general purpose enclosures with padlock ears, except in wet locations or out of doors shall be NEMA 3R with conduit hubs, or units in hazardous locations which shall have NEC proper class and division.
 - 2. Manual switches shall have pilot lights and extra positions for multi-speed motors.
 - 3. Overload protection: melting alloy type thermal overload relays.

4. Phase Loss Protection: Where not protected otherwise, motor starters for 3-phase motors shall have built in phase loss protection.
- E. Magnetic Starters:
1. Maintained contact push buttons and pilot lights, properly arranged for single speed or multi-speed operation as indicated.
 2. Trip-free thermal overload relays, each phase.
 3. Interlocks, pneumatic switches and similar devices as required for coordination with control requirements of mechanical equipment. Multi-Speed starters shall be provided with integral time delay transition between "FAST" and "SLOW" speeds.
 4. Built-in 120 volts' control circuit transformer, fused from line side, where service exceeds 240 volts.
 5. Externally operated manual reset.
 6. Under-voltage release or protection.
- F. Motor Connections: Liquid-tight flexible conduit, except where plug-in electrical cords are specifically indicated.
- G. Combination Non-Reversing Starters: Provide full voltage alternating-current combination non-reversing starters, consisting of starter and disconnect switch mounted in common enclosure, of types, sizes, ratings, and NEMA sizes as required. Equip starters with electrical interlocks for interfacing with other starters. Equip starters with block type manual reset overload relays and with fusible disconnect switches.
- H. Provide operating handle for disconnect mechanism with indication and control of switch position, with enclosure door either opened or closed, and capable of being padlocked in OFF position. Construct and mount starters and disconnect switches in single NEMA Type 1 enclosure: coat with manufacturer's standard color finish.
- I. AC Fractional HP Manual Starters: Provide single-phase fractional HP manual motor starters, of sizes and ratings required. Equip with manually operated quick-make, quick-break toggle mechanisms; and with one-piece melting alloy type thermal units. Starter to become inoperative when thermal unit is removed. Provide starters with double break silver alloy contacts, visible from both sides of starter; green pilot lights and switch capable of being padlocked OFF. Enclose starter unit in NEMA Type 1 general purpose enclosure suitable for flush mounting; coat with manufacturer's standard color finish.
- 2.4 WIRING:
- A. Low voltage wiring shall be no. 18 rubber covered, color coded wire or cable. Line voltage wiring shall be not smaller than #12 600-volt wire. All wire shall be run in rigid conduit with outlet boxes and fittings in a manner comparable to that specified in the electrical specifications. All ground wire shall be THHN for line voltage. All wire will be pulled to every pump, disconnect, starter motor etc. Conduit shall not be used as ground.
- 2.5 DISCONNECTS:
- A. Non-Fused.

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

B. Fused Disconnect Switches

1. Single throw, quick-make, quick-break Number of poles as required by load. NEMA-1 general purpose enclosure indoors in dry locations, NEMA 3R weatherproof enclosure outside or inside in wet locations. Standard fuse clips, lockable in open position. Rating 250 or 600 VAC as required.
2. Accessories: Provide a shield and a strap for removing the fuse.
3. Make - General Electric, Square D, Westinghouse.

2.6 MOLDED CASE CIRCUIT BREAKERS (MCCB):

A. Manufacturers: Subject to compliance with requirements, provide MCCB's of one of the following:

1. Cutler-Hammer/Westinghouse
2. General Electric
3. Siemens
4. Square D

B. General: MCCB's shall be industrial grade (bolt-on) with ratings and special features as scheduled on drawings. Trips shall be thermal magnetic with inverse time delay and instantaneous time-current characteristics. 225 ampere frame and larger MCCB's shall have interchangeable trips and adjustable magnetic feature. MCCB's used outdoors shall have ambient compensating trips. MCCB's used for switching lights shall be rated for switching duty and shall be so labeled. MCCB's used for overcurrent protection for HVAC equipment shall be rated "HACR" type and shall be so labeled. MCCB's to be installed in existing panelboards shall be of the same manufacturer as the panelboard.

C. Ganged use of single-pole breakers for multi-pole applications is not acceptable.

PART 3: EXECUTION

3.1 INSTALLATION:

- A. Install motors on motor mounting systems in accordance with motor manufacturer's instructions, securely anchored to resist torque, drive thrusts, and other external forces inherent in mechanical work. Secure sheaves and other drive units to motor shafts with keys and Allen set screws, except motors of 1/3 hp and less may be secured with Allen set screws on flat surface of shaft. Unless otherwise indicated, set motor shafts parallel with machine shafts.
- B. Install motor starters, in accordance with equipment manufacturer's written instructions and with recognized industry practices; complying with applicable requirements of NEC, UL and NEMA standards, to ensure that products fulfill requirements.
- C. Coordinate with other work including motor and electrical wiring/cabling work, as necessary to interface installation of motor starters with other work.

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

3.2 ADJUSTING AND CLEANING

- A. Inspect electrical starter's operating mechanisms for malfunctioning and, where necessary, adjust units for free mechanical movement.
- B. Touch-up scratched or marred surfaces to match original finish.

3.3 FIELD QUALITY CONTROL:

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

END OF SECTION 230530

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SECTION 230545 - MECHANICAL RELATED WORK

PART 1: GENERAL

1.1 RELATED DOCUMENTS AND RELATED WORK SPECIFIED ELSEWHERE

A. Related Documents

1. Drawings, Standard General Conditions of the Construction Contract, including Supplementary General Conditions, Division-01 Specification sections and other Division 23 specification sections, Division 22, Division 26, Division 28 and Division 31 specifications apply to work of this section.

1.2 DESCRIPTION OF WORK

A. Types of mechanical related work specified in this section include the following:

1. Concrete for Mechanical Work

1.3 QUALITY ASSURANCE

- A. Concrete Work Codes and Standards: Comply with governing regulations and, where not otherwise indicated, comply with the following industry standards, whichever is the most stringent in its application to work in each instance:
 1. ACI 301, "Specifications for Structural Concrete for Buildings".
 2. ACI 318, "Building Code Requirements for Reinforced Concrete".
 3. ACI 347, "Recommended Practice for Concrete Formwork".
 4. ACI 304, "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete".
 5. Concrete Reinforcing Steel Institute's, "Manual of Standard Practice".
- B. Shop Drawings, Mechanical Concrete Work: Submit shop drawings for structural type concrete work (tanks, vaults, basins, foundations and other supports), showing dimensions of formed shapes of concrete; bending, placement, sizes and spacing of reinforcing steel; location of anchors, isolation units, hangers and similar devices to be integrated with concrete work; and piping penetrations, access openings, inlets and other accessories and work to be accommodated by concrete work.
- C. Laboratory Test Reports, Mechanical Concrete Work: Submit laboratory test reports for concrete work materials, and for tested samples of placed concrete (where required as work of this section)
- D. Set-Control Additives shall not be used without approval by the Contracting Officer's Representative.
- E. Prohibited Admixtures: Calcium Chloride or admixtures containing more than 0.1% chloride ions are not permitted.

PART 2: PRODUCT

2.1 MATERIALS OF CONCRETE WORK:

A. Form Materials and Construction:

1. Forms for Exposed Concrete: Plywood, smooth metal or other smooth panel type material; sized for minimum joint exposure and reinforced to prevent visible deflections resulting from pressure of placed concrete; sufficiently heavy for construction to prevent leakage which would be harmful to either structural or visual quality of concrete.

B. Plywood: PS-1 "BB (Concrete Form) Plywood", Class I, Exterior Grade, mill-oiled and edge sealed.

2. Forms for Unexposed Concrete: Smooth lumber, plywood or other easy-release material; reinforced to prevent excessive deflection or the possibility of failure during placement of concrete; sufficiently heavy for construction to prevent leakage which would be harmful to structural quality of concrete.
3. Exposed-Corner Chamfer Strips: Provide wood, metal, plastic or rubber chamfer strips in forms at exposed external corners of concrete work.
4. Form-Coating Compound: Commercially formulated compound which will prevent bond of concrete to forms. Provide compound recommended by manufacturer for application indicated, and which will not stain concrete or interfere with moisture curing of concrete or subsequent painting of exposed surfaces. Provide environmentally friendly products.

C. Reinforcing Materials:

1. Reinforcing Bars: Except as otherwise indicated, provide ASTM A 615, deformed, Grade 60; sizes as indicated.
2. Steel Wire: ASTM A 82, plain, cold-drawn.
3. Welded Wire Fabric: ASTM A 185; sizes and spacing of wires as indicated; 6" x 6" x No. 10 x No. 10 where not otherwise indicated.
4. Reinforcement Supports: Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Provide wire bar type supports complying with CRSI recommendations, unless otherwise indicated.

D. Concrete Materials:

1. Portland Cement: ASTM C 150, Type I, except as otherwise indicated.
2. Aggregates: ASTM C 33, except as otherwise indicated.
3. Water: Clean and free of substances harmful to concrete.

E. Air-Entraining Admixture:

1. ASTM C 260.

F. Miscellaneous Materials:

1. Waterstops: Provide either rubber or PVC waterstops of types and sizes indicated or if not otherwise indicated, provide types and sizes recommended by manufacturer for application indicated. Comply with Corps of Engineers CRD-C513 or CRD-C572 (as applicable).

2.2 DESIGN AND PROPORTIONING OF MIXES

- A. General: Design mechanical work concrete as follows, for each 28-day compressive strength class:
1. 4000 psi Class: 565 lbs. of cement per cu. yd. (6.0 sacks), and 0.35 water/cement ratio.
 2. 3000 psi Class: 500 lbs. of cement per cu. yd. (5.25 sacks), and 0.46 water/cement ratio.
 3. 2500 psi Class: 450 lbs. of cement per cu. yd. (4.75 sacks), and 0.54 water/cement ratio.
 4. Backfill Class (Lean Concrete): 375 lbs. of cement per cu. yd., (4.0 sacks), and 0.60 water/cement ratio.
 5. Rough Grouting Class: 565 lbs. of cement per cu. yd. (6.0 sacks), and 0.60 water/cement ratio.
- B. Slump Limitations: Limit water content in design mixes to produce the following slumps at point of placement (but do not exceed specified water/cement ratios). Concrete containing high-range water-reducing admixture may have slump limit up to 8".
1. Reinforced Structural Concrete: For concrete which is reinforced (with more than shrinkage crack protection), or in strength class of 3000 psi and above, limit slump to range of 1" to 3".
 2. Plain Concrete: For concrete which is not reinforced or reinforced only for shrinkage crack protection, and in strength class below 3000 psi, limit slump to range of 2" to 5".
 3. Rough Grout Concrete: Limit slump to range of 3" to 7".
 4. Backfill Concrete: Limit slump to 5".
- C. Mix for Patching: Where mechanical work requires patching of exposed concrete work which has been cut to accommodate mechanical work, provide concrete patching mix which is identical with mix of work being patched (same cement, aggregates, admixtures and proportioning).

2.3 CONCRETE MIXING

- A. Job-Site Mixing: Job-site mixing of concrete is permissible only for incidental concrete work. Mix materials for concrete in drum-type batch machine mixer. For mixers of 1.0 cu. yd., or smaller capacity, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after all ingredients are in mixer, before any part of batch is released. For mixers of capacity larger than 1.0 cu. yd., increase mixing time by 15 seconds for each additional cu. yd., or fraction thereof.
- B. Ready-Mix Concrete: Comply with requirements of ASTM C 94, except as otherwise indicated. Addition of water to batch will not be permitted. During hot weather, or under conditions contributing to rapid setting of concrete, mix each load for shorter period of time than specified in ASTM C 94. When air temperature is between 85 and 90 deg.F (29.4 and 32.2 deg.C), reduce mixing and delivery time from 90 minutes to 75 minutes, and when air temperature is above 90 deg.F (32.2 deg.C), reduce mixing and delivery time to 60 minutes.

PART 3: EXECUTION

3.1 INSTALLATION OF CONCRETE WORK:

- A. Formwork:
1. General: Design, construct and maintain formwork to support vertical and lateral loads including pressure of cast-in-place concrete. Construct formwork so that formed concrete will be required size and shape and in required location. Construct with joints which will not leak cement paste. Form sides and bottoms of concrete work, except where clearly indicated

- to be cast directly in excavation or against other construction, or on grade or prepared subgrade. Design and construct forms for easy removal without damage to concrete and other work. Install chamfer strips at external corners of exposed concrete work. Install formwork in full compliance with OSHA safety standards.
2. Placing Reinforcement:
 3. General: Comply with requirements and recommendations of specified standards, including "Placing Reinforcing Bars" by CRSI. Place bars where indicated and support to prevent displacement during concrete placement, using appropriate reinforcement supports, properly spaced and wire tied to reinforcing bars.
 4. Placing Concrete:
 5. Strength-Class Applications: Comply with compressive-strength-classes shown on drawings for each unit of mechanical concrete work or, if not shown, comply with the following general application requirements.
 - a. Plain Concrete Encasement: Provide 2500 PSI class.
 - b. Reinforced Concrete Encasement: Provide 3000 PSI class.
 - c. Underground Structural Concrete: Provide 3000 PSI class.
 - d. Tanks and Vaults: Provide 4000 PSI class.
 - e. Block-Type Foundations: Where least dimension is not less than 0.2 x largest dimension, provide 3000 PSI class.
 - f. Beam-Type Foundations: Where least dimension is less than 0.2 x largest dimension, provide 4000 PSI class.
 - g. Miscellaneous Supported Work: Provide 3000 PSI class for curbs, pads, inertia blocks and similar supported work.
 - h. Concrete Fill: Provide 2500 PSI class for filling structural steel foundation frames and for filling similar large-volume units.
 - i. Concrete Grout: Provide rough grouting class for filling voids to be grouted which are too small to be filled effectively with 2500 PSI class concrete.
 - j. Patching General Concrete Work: Match concrete being patched.
 6. Deposit concrete continuously or in layers of thickness which will result in no concrete being placed on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within section. If section cannot be placed continuously, provide construction joints. Deposit concrete as nearly as practicable in its final location, so as to avoid segregation due to rehandling or flowing.
 7. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Use equipment and procedures complying with recommended practices of ACI 309; eliminate voids in work.
 8. Bring horizontal surfaces to correct level with straightedge and strike off. Use bull floats or darbies to smooth surface, free of humps and hollows.
 9. Cold Weather Placement: Comply with ACI 306. Do not use frozen materials or materials containing ice and snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials. When air temperature has fallen or is expected to fall below 40 deg.F (4.4 deg.C), heat water and aggregates uniformly before mixing, as required to obtain concrete mixture temperature of not less than 50 deg.F (10 deg.C), and not more than 80 deg.F (26.7 deg.C), at time of placement. Protect concrete work from physical damage and reduced strength resulting from frost, freezing actions, or low temperatures.
 10. Hot Weather Placement: Comply with ACI 305 when hot weather conditions could impair work. Maintain concrete temperature below 90 deg.F (32.2 deg.C) at time of placement, by cooling ingredients. Mixing water may be chilled or chopped ice may be used to control concrete temperature, provided water equivalent of ice is included in calculating compliance

with water/cement ratio limitations. Cover reinforcing steel with water-soaked burlap as necessary to ensure that steel temperature will not exceed ambient air temperature immediately before embedment in concrete.

11. Finishing Horizontal Surfaces: Float and trowel horizontal (top) surfaces to level, smooth, uniform textured, dense finish, where surface is to remain exposed or receive coating, membrane or other thin-set finish. Otherwise, leave struckoff surface undisturbed; except scratch surfaces which are to receive concrete or mortar topping or setting bed, by raking with a stiff broom.
12. Curbs: Provide monolithic finish on interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to hard, dense finish with corners, intersections and terminations slightly rounded and coved.

3.2 MISCELLANEOUS CONCRETE WORK

- A. Concrete Grouting: Grout openings and recesses in and around mechanical work and other work which penetrates or adjoins mechanical concrete work, using rough grouting class of concrete mix. Provide formwork where required, and tamp, screed and trowel surfaces.

END OF SECTION 230546

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SECTION 230548 - SEISMIC RESTRAINTS

PART 1: GENERAL

1.1 RELATED DOCUMENTS AND RELATED WORK SPECIFIED ELSEWHERE:

A. Related Documents

1. Drawings, Standard General Conditions of the Construction Contract, including Supplementary General Conditions, Division-01 Specification sections, other Division 23 specification, and Division 26 Specification sections apply to work of this section.

B. The scope of work includes the work required in the following sections.

1.2 QUALITY ASSURANCE:

- A. Codes and standards: Provide seismic restraint in accordance with the North Carolina Building Code and SMACNA standards.

PART 2: PRODUCTS: NOT USED

PART 3: EXECUTION

3.1 INSTALLATION

- A. The Contractor shall be responsible for providing restraints to resist the earthquake effects on the mechanical system. The requirements for these restraints are found in Chapter 16, Section 1613 of the 2018 North Carolina Building Code (International Building Code, 2015).
- B. For this project: County: New Hanover
 1. Risk Category: II
- C. Seismic Design Category: C
- D. Nonstructural component anchorage: Mechanical and Electrical Components with an importance factor of 1.0 in Seismic Design Categories A, B, or C are **exempt** from the Seismic Design requirements as specified in NCSBC with reference to ASCE 7.

END OF SECTION 230548

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SECTION 230571 - ADJUSTABLE SPEED DRIVES

PART 1: GENERAL

1.1 RELATED DOCUMENTS AND RELATED WORK SPECIFIED ELSEWHERE:

A. Related Documents

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

1.2 REFERENCES

- A. NEMA ICS 3.1 - Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- C. Adjustable speed drive, including all factory installed options, shall have UL & CSA approval.
- D. IEEE Standard 519
- E. IEC: 146A

1.3 SUBMITTALS

- A. Submit Manufacturer's technical product data and installation instructions.
- B. Shop drawings shall include; wiring diagrams, front and side views of enclosures, overall dimensions, conduit entrance locations and requirements, nameplate legends, and enclosure details.
- C. Product Data: Provide data sheets showing; voltage, ratings and size of switching and overcurrent protective devices, short circuit ratings, and weights.
- D. Product Data: Provide data for enclosure, heat dissipation and airflow requirements.
- E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of adjustable speed drive.

1.4 QUALITY ASSURANCE

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

1.5 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of this Section. Include instructions for starting and operating ASD, and describe operating limits, that may result in hazardous or unsafe conditions.

1.6 QUALIFICATIONS

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

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Accept ASD on site in original packing. Inspect for damage.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover, to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully, in accordance with manufacturer's written instructions, to avoid damage to components, enclosure, and finish.

1.8 WARRANTY

- A. Provide ASD warranty, for two years from date of final acceptance. Warranty shall include parts, and labor, living expenses and travel costs. The warranty shall be provided by the ASD manufacturer, not a third party. A written warranty statement shall be provided with submittals.

PART 2: PRODUCTS

2.1 MANUFACTURERS

- A. ASD shall be manufactured by ABB, Cutler Hammer, Danfoss Graham, Honeywell, or Square D.

2.2 DESCRIPTION

- A. Provide enclosed adjustable speed drives suitable for operating at the current, voltage, and horsepower indicated on the plans. The ASD shall be designed specifically for use in Heating, Ventilation, and Air Conditioning (HVAC) applications in which speed control of the motor can be applied. ASD's shall include communications capability with DDC BMS via built-in interface card (LonMark, MODBUS or BACnet).
- B. Conform to requirements of NEMA ICS 3.1. Provide NEMA 3R enclosure for outdoor environment.

2.3 RATINGS

- A. ASD must operate, without fault or failure, when voltage varies plus or minus 10 percent from rating, and frequency varies plus or minus 5 percent from rating.
- B. Displacement Power Factor: 0.98 over entire range of operating speed and load.
- C. Operating Ambient Temperature: -15 degrees C. to 40 degrees C. (5 degrees F. to 104 degrees F.)
- D. Humidity: to 95% rh.
- E. Altitude: to 3300 feet, higher by derating.

- F. Minimum Efficiency: 96% at half speed; 97% at full speed and name plate motor speed.
- G. Starting Torque: 120% starting torque shall be available from 0.5 Hz. to 60 Hz.
- H. Overload capability: 110% of rated F.L.A. (full load amps) for 60 seconds; 150% of rated F.L.A., instantaneous.
- I. The ASD must meet the requirements for Radio Frequency Interference (RFI) above 7 MHz as specified by FCC regulations, part 15, subpart J, Class A devices.
- J. In compliance with IEEE 519, the Total Harmonic Distortion for the ASD shall be no greater than 5%. When the THD is above 5% the supplier of the ASD shall provide line reactors.
- K. Provide a 3% load side reactor on each adjustable speed drive.

2.4 DESIGN

- A. ASD shall employ microprocessor-based inverter logic, isolated from all power circuits.
- B. ASD shall include surface mount technology, with conformal coating.
- C. ASD shall employ a PWM (pulse width modulated) inverter system, consisting of:
 - 1. Input Section:
 - a. ASD input power stage shall convert three-phase AC line power into a fixed DC voltage via a solid state full wave diode rectifier, with MOV (metal oxide varistor) protection.
 - 2. Intermediate Section:
 - a. DC bus as a supply to the ASD Output Section shall maintain a fixed voltage with filtering and short circuit protection.
 - b. DC Bus shall be interfaced with the ASD diagnostic logic circuit, for continuous monitoring and protection of the power components.
 - 3. Output Section
 - a. Insulated gate bipolar transistors (IGBT's) shall convert DC bus voltage to variable frequency and voltage.
 - b. PWM sine coded output to the motor.
- D. The ASD must be amp rated at carrier frequencies at or above 10 kHz. Exception to this requirement is allowed only for ASDs providing 104 amps or more.
- E. The ASD must be selected for operation at carrier frequencies at or above 10 kHz to satisfy the conditions for current, voltage, and horsepower as indicated on the equipment schedule.
- F. ASD shall have an adjustable carrier frequency.
- G. ASD shall include two independent remote reference inputs. One shall be 4-20 ma. The other shall be 0-10 VDC. Either input shall respond to a programmable bias and gain.

- H. ASD shall include a minimum of three multi-function input terminals, capable of being programmed, to determine their function when their state is changed. These terminals shall provide up to 20 functions, including, but not limited to:
 - 1. Remote/Local operation selection.
 - 2. Detection of external overheat condition.
- I. ASD shall include a 0-10V DC analog output, proportional to frequency or current, for either monitoring, or "speed tracking" the ASD.
- J. ASD shall provide terminals for remote contacts, to allow starting in the automatic mode.
- K. ASD shall include at least one external fault input, which shall be programmable, for either a normally open, or a normally closed contact, for connection to firestats, freezestats, etc.
- L. ASD shall include a minimum of three multi-function output terminals, one of which shall be a fully rated form "C" contact, capable of being programmed, to determine what conditions must be met, in order for them to change their state. These terminals shall provide up to 15 functions, including, but not limited to:
 - 1. Zero speed detection.
 - 2. Low and high frequency detection.
 - 3. Missing frequency reference detection.
 - 4. Overtorque detection
- M. ASD shall include a power loss ride thru of 2000 milliseconds (2 seconds).
- N. ASD shall include a front mounted, sealed keypad operator, with a digital display, to provide complete programming, operating, monitoring, and diagnostic capability. Keys provided shall include commands for RUN, STOP, and RESET. Operating mode (auto or manual) and speed setting functions shall also be provided.
- O. ASD display shall provide readouts of; output frequency in hertz, output voltage in volts, output current in amps, output power in kilowatts, D.C. bus voltage in volts, interface terminal status, and fault codes.
- P. ASD shall be capable of PID (Proportional, Integral, Derivative) logic, to provide closed-loop setpoint control capability, from a remote reference.
- Q. ASD shall include loss of input signal protection, with a speed default to 80 % of the most recent speed.
- R. ASD shall include electronic thermal overload protection for both the drive and motor, profilable for variable or constant torque.
- S. ASD shall include the following programming functions:
 - 1. Critical frequency rejection capability: 3 selectable, adjustable bands.
 - 2. Auto restart capability: 0 to 10 attempts.(Provide automatic soft restart when power comes back on after a power failure or after a fire alarm shut-down signal has been cleared.)
 - 3. Stall prevention capability.
 - 4. "S" curve soft start capability.
 - 5. "Speed search" capability, in order to start a rotating load.

6. 15 preset volts per hertz patterns.
 7. One adjustable volts per hertz pattern.
 8. Current limit adjustment capability, from 30 % to 200 % of rated full load current of the ASD.
 9. Anti "wind milling" function capability.
- T. ASD shall include factory settings for all parameters, and the capability to be reset back to those settings.
- U. ASD shall include the capability to adjust the following functions, while the ASD is running:
1. Acceleration adjustment from 0 to 600 seconds.
 2. Deceleration adjustment from 0 to 600 seconds.
 3. A minimum of three different preset speeds.
 4. Analog output gain, to calibrate the signal for the application used.
- V. ASD shall have built in phase loss protection.
- W. Manual Bypass shall be provided. Bypass components shall be separately housed. Bypass shall include the following:
1. Input, output, and bypass contactors, to disconnect power to the ASD, when the motor is running in the bypass mode.
 2. 115 V.A.C. control transformer, with fused primary.
 3. Thermal overload relay, to protect the motor while operating in the bypass mode.
 4. Circuit breaker/disconnect switch, with a "through-the-door" handle mechanism.
 5. Control and safety circuit terminal strip.
 6. "Drive-Off-Bypass" selector switch.
 7. Pilot lights for "Power On", "Running on Drive", "Running on Bypass" and "Fault".
- X. A main circuit breaker disconnect shall be provided for the ASD. For outdoor location, the circuit breaker shall be operable from the front of the NEMA rated enclosure.
- 2.5 PROVIDE PRODUCT OPTIONS AS FOLLOWS:
- A. Manual Bypass Options:
1. "Auto/Manual" selector switch, to provide convenient switching between "manual" and "auto" modes.
- B. Current limiting, fast acting input fusing, for the protection of ASD semiconductor devices.
- C. Serial communications gateway, for either RS-232 or RS-485, to provide interface from an ASD to; a computer, a Program Logic Controller (PLC), or Building Automation System, for those units which need to interface with such.
- D. NEMA 3R Enclosure with mechanical ventilation for warm weather and heater for cold weather or prevention of condensation.
- 2.6 FABRICATION
- A. Enclosure for indoor locations: NEMA 1. Primary switches and indicating lamps for drive function and USB connection shall be provided on the enclosure.

- B. Enclosure for outdoor locations: The ASD and bypass shall be contained in NEMA Type 3R enclosure and assembled as ASD manufacturer's standard package. Primary switches and indicating lamps for drive function and weatherproof USB connection shall be provided on the enclosure.
- C. The disconnecting means shall be by circuit breaker accessible from the panel door.

2.7 SOURCE QUALITY CONTROL

- A. In-circuit testing of all printed circuit boards shall be conducted, to insure the proper mounting and correct value of all components.
- B. All printed circuit boards shall be burned in for 96 hours, at 85 degrees C.
- C. Final printed circuit board assemblies shall be functionally tested, via computerized test equipment. All tests and acceptance criteria shall be preprogrammed. All test results shall be stored as detailed quality assurance data.
- D. All fully assembled controls shall be functionally tested, with fully loaded induction motors. The combined test data shall then be analyzed, to insure adherence to quality assurance specifications.
- E. Inspect and production test, under load, each completed ASD assembly.

2.8 SURGE PROTECTION

- A. Provide surge protection on the input side of the ASD using a three-phase reactor with a metal oxide varistar (MOV). This protection shall be rated at 5% impedance, 600 volts maximum, 50/60 Hz.

PART 3: EXECUTION

3.1 EXAMINATION

- A. Verify that surface is suitable for ASD installation.

3.2 INSTALLATION

- A. Install ASD where indicated, in accordance with manufacturer's written instructions and NEMA ICS 3.
- B. Shading from sun shall be provided for outdoor locations.
- C. Tighten accessible connections and mechanical fasteners after placing ASD.
- D. Provide neatly typed label on each ASD, identifying nameplate horsepower, full load amperes, model number, service factor and voltage/phase rating.
- E. Facilitate work by and provide assistance to the manufacturer's representative.

3.3 FIELD QUALITY CONTROL

- A. The manufacturer's representative shall inspect and certify that the installation is in accordance with manufacturer's recommendations. Installation Contractor will correct all deficiencies identified by the manufacturer's representative.
- B. Inspect completed installation for physical damage, proper alignment, anchorage, and grounding. The Installation Contractor and the Manufacturer's representative will both perform the inspection. Installation Contractor will correct all deficiencies identified.

3.4 MANUFACTURER'S FIELD SERVICES

- A. Provide factory trained and authorized startup technician to startup, tune, and test ASD. Warranty shall begin after completion of startup and acceptance testing. Installation Contractor shall facilitate and provide needed assistance.
- B. Provide O&M manuals and training for Owner's facility maintenance personnel.

END OF SECTION 230571

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SECTION 230590 - MECHANICAL PAINTING AND IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS AND RELATED WORK SPECIFIED ELSEWHERE:

A. Related Documents

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

1.2 SCOPE

A. The mechanical contractor shall contract the services of a professional painting subcontractor to do the required painting.

1. Color coded painting of pipes to indicate what is being conveyed in the pipes will not be required.
2. All uninsulated piping and equipment not concealed in chases or above ceilings shall be painted to match surroundings, except gas piping shall be painted yellow.
3. All insulated piping and equipment exposed to view in public spaces shall be painted unless provided with an aluminum jacket.
4. The mechanical contractor shall be responsible for labeling the mechanical piping and equipment after it is painted.

B. Identify the following:

1. All mechanical equipment
2. All electrical equipment associated with mechanical equipment, including disconnects, panels, ASD's, etc.
3. Control panel and visible control components.
4. Condensate drains that extend more than 10' from the unit.
5. Fire damper access panels
6. Provide maintenance and emergency repair contact information for all equipment on labels placed on an easily visible location on the equipment.

1.3 SUBMITTALS:

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

1.4 QUALITY ASSURANCE:

A. All painting shall be performed by a company regularly engaged in painting using full time painting employees.

PART 2: PRODUCTS

2.1 PIPE STENCILING

- A. Lettering: Manufacturer's standard pre-printed nomenclature which best describes piping system in each instance.
- B. Size of Pipe Identification:

	OD Pipe or Covering	Length of Background Color Field	Stencil Letter Size
1.	3/4 in. thru 1-1/4 in.	8 in.	1/2 in.
2.	1-1/2 in. thru 2 in.	8 in.	3/4 in.
3.	2-1/2 in. thru 6 in.	12 in.	1-1/4 in.
4.	8 in. thru 10 in.	24 in.	2-1/2 in.
5.	Over 10"	32 in.	3-1/2 in.

- C. Arrows: Include arrows indicating direction of flow, with piping system service lettering.

2.2 ENGRAVED PLASTIC-LAMINATE SIGNS AND EQUIPMENT MARKERS:

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

PART 3: EXECUTION

3.1 PAINTING:

- A. All equipment, except where otherwise specifically noted, shall be furnished in prime coat. All uninsulated black steel piping shall be prime coated and finish painted in light gray unless otherwise required by schedule below to be color coded. All welds, on both insulated and uninsulated piping, shall be painted with one coat of primer. All miscellaneous black steel items such as machinery supports, breechings and stacks, etc., shall be prime coated and finish painted in light gray. All hangers, rods, supports and connections shall be galvanized coated. Exposed surfaces of insulation shall be sealed. All metal surfaces shall be thoroughly cleaned of rust and dirt and shall be degreased before application of primer. All prime coated equipment shall be touched up where prime coats are chipped, scratched, or otherwise damaged. All prime coated equipment shall be thoroughly cleaned and left ready for finish painting. Where cast iron accessories or galvanized pipe, or equipment surfaces are to receive finish painting, the item shall be properly primed.
- B. Ferrous surfaces shall be painted with the following coats:
 - 1. 1 coat of primer equivalent to Bruning Silathane 520-14 grey-green primer, Benjamin Moore 06- 20 red oxide alkyd primer or Richards SR-1399 red metal primer.
 - 2. 2 coats of finish equivalent to Bruning Silathane Gloss Enamel 520-32 quarry gray, Benjamin Moore Gloss Enamel 22-38 or Richards Gloss Enamel 1003 Series.
- C. The interiors of ductwork visible through grilles, registers, diffusers, or other duct openings, and/or interiors that can reflect light shall be painted flat black.

3.2 IDENTIFICATION SCHEDULE

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

ITEM	IDENTIFICATION	MARKER BACKGROUND COLOR	LETTERING COLOR
1. Condensate Drain	CD	White	Black
2. Fire Damper Access	FIRE DAMPER	Duct	Red

- B. Size of lettering shall be the as indicated in paragraph 2.01.C above.

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

3.3 GENERAL MECHANICAL IDENTIFICATION:

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

3.4 PIPING SYSTEM IDENTIFICATION

- A. General: Install plastic pipe markers or stenciling on each system indicated to receive identification.
- B. Locate pipe stenciling as follows:

1. Near each valve and control device.
2. Near each branch.
3. Near locations where pipes pass through walls, floors, ceilings, roofs or enter non-accessible enclosures.
4. Near major equipment items and other points of origination and termination.

- C. Stenciling: Apply stenciling after finished painting has been completed. Stencil indication shall be in block letters, applied with black paint (except white paint on dark surface) as follows:

- D. All underground lines outside the building footprint, shall have a warning tape installed in the backfill between 6 inches to 24 inches below finished grade directly over piping.

1. Metallic lines shall be identified with durable printed plastic warning tapes, minimum 3 inches wide, with lettering to identify buried line below.
2. Non-metallic pipes, other than gas lines, shall be identified by detectable warning tape, minimum 2 inches wide, with lettering to identify buried line below.
3. Tracer: A yellow insulated copper tracer wire or other approved conductor shall be installed adjacent to underground nonmetallic piping. Access shall be provided to the tracer wire or the tracer wire shall terminate aboveground at each end of the nonmetallic piping. The tracer wire size shall not be less than 14AWG and the insulation type shall be listed for direct burial.

3.5 MECHANICAL EQUIPMENT IDENTIFICATION:

- A. General: Install engraved plastic laminate sign or plastic equipment marker on or near each major item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:
1. Air Handling Units, Outdoor Condensing Units, and Similar Units.
 2. Packaged Heat Pump Units.
 3. Main control and operating switches, including safety devices and hazardous units such as gas outlets.
 4. Exhaust and Relief Fans.
 5. Adjustable speed drives.
 6. Electric unit heater.

END OF SECTION 230590

SECTION 230594 - TESTING AND BALANCING OF HVAC SYSTEMS

PART 1: GENERAL

1.1 RELATED DOCUMENTS AND RELATED WORK SPECIFIED ELSEWHERE:

A. Related Documents

1. Drawings, Standard General Conditions of the Construction Contract, including Supplementary General Conditions, Division-01 Specification sections, other Division 23 specification sections, and Division 26 specifications apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. The Testing and Balancing Agency (TAB) shall be selected and hired by the Contractor and shall be certified by the Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB). The Agency shall show proof of having successfully completed at least five projects of equal size and scope within the previous three years and shall have on its staff a full-time Professional Engineer registered in the State of North Carolina.
- B. Immediately after the award of a contract, the contractor shall perform a Design Review of the mechanical plans and specifications. He shall identify any omissions or discrepancies that will preclude the proper balancing of the systems and report same to the Construction Manager in a formal report.
- C. Test and balance HVAC air systems as shown and specified on the schedules and Contract Documents and make submittals as described in this Section.
- D. The building mechanical systems for this project will be commissioned by a commissioning agent. The contractor shall provide all material and resources necessary to ensure compliance with the requirements of specification section 01 91 13 – general commissioning requirements, and with the requirements of the commissioning plan.

1.3 SUBMITTALS - Submit the following to the Owner's Representative for approval:

- A. Inspection reports (prior to and during testing and balancing).
- B. Other tests, records, certifications and reports as specified in this Section.
- C. Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB) Certification
- D. List of instruments actually used for each test. Include instrument calibration dates.
- E. TAB report including preliminary and final balance data sheets) (see Paragraph 3.05). Also, submit to Engineer for record.

1.4 REFERENCE STANDARDS

- A. Unless shown or specified otherwise, the TAB work shall comply with the following:

1. AABC National Standards or National Environmental Balancing Bureau (NEBB) Standards for Field measurements and Instrumentation.
2. HVAC Systems Testing, Adjusting, and Balancing, Sheet Metal & Air Conditioning Contractor's National Association, Inc. (SMACNA), latest edition.

1.5 QUALITY ASSURANCE

- A. The organization performing the TAB work shall be certified by the Associated Air Balance Council (AABC) or the National Environmental Balancing Bureau (NEBB).
- B. The work shall be performed by regular employees specifically trained in the total balancing of air systems. The work shall be continuously conducted under the direct supervision of a Professional Engineer registered in the State of North Carolina who is a certified Test and Balance Engineer by AABC or NEBB and is experienced in testing and balancing of HVAC systems.

PART 2: PRODUCTS

NOT USED

PART 3: EXECUTION

3.1 GENERAL

- A. Adjust, test and confirm air flow rates, pressure drops, pressures, temperature and heat transfer performance of HVAC system, including supply, return, outdoor air, transfer, relief and exhaust systems.
- B. Provide preliminary and final (2 phases) testing and balancing. Initiate preliminary testing and balancing immediately after certification of fan (before controls, ceilings, walls, etc. are completed). Confirm macro level performance of devices. The preliminary phase shall be followed by a submitted written report of system shortcomings which prohibit final balancing. Following preliminary testing and balancing, if balancing or control devices are not operating correctly, report these conditions to the Owner's Representative, who shall coordinate required corrections so that balancing can continue.
- C. Perform the work using methods and test forms published by AABC National Standards for Field Measurements and Instrumentation (No. 71679, 2nd edition or any later edition) or corresponding NEBB methods and forms.
- D. Do not start final testing and balancing until each system has been certified to be complete.
- E. Using controls and devices installed, test and balance air conditioning systems with maximum attainable internal load (lights and equipment), or simulated maximum load using automatic temperature controls, whichever is closest to design operating conditions.
- F. Do the final testing and balancing of air handling systems with finished ceilings and partitions in place and doors closed.

- G. Use volume control devices to regulate air quantities only to the extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- H. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation. Minimize use of balancing devices to “throttle” flow. When balanced, all volume control devices in the path to the terminal with the highest-pressure drop shall be fully open.
- I. Adjust OA intake to AHU’s according to drawings, schedules, and specifications.
- J. For fans having ASDs, set the maximum speeds to provide the maximum scheduled air volumes.
- K. Have on the job site the Associated Air Balance Council (AABC) or the National Environmental Balancing Bureau (NEBB) standards referred to herein and make them available to the Mechanical Contractor and the Owner’s Representative.
- L. The Owner’s Representative shall witness final testing and balancing of all system. The Testing and Balancing Contractor shall notify the Owner’s Representative ten (10) working days prior to each system being tested and/or balanced.
- M. Repair or replacement of finished products damaged as a result of testing, balancing and inspection work shall be the responsibility of the Contractor.

3.2 INSTRUMENT CALIBRATION

- A. Provide written certification of the accuracy of all instruments furnished or used for Testing and Balancing. Show date and method of calibration. All instruments shall have been calibrated within six (6) months prior to the estimated completion date of balancing work.
- B. Verify the accuracy of permanently-installed flow-measuring primary elements and their read-out instruments, thermometers, sensors and pressure gauges furnished under this contract. Verification may be by calculation and calibration of the primary element and read-out instrument, or by an independent measurement of the flow, temperature or pressure of the flow, of the same flowing medium using calibrated instruments. Submit a report of certification, verification, or inaccuracy of all calibrations.

3.3 BALANCING PROCEDURES AND RELATED WORK

- A. Balancing shall achieve design air, within a tolerance of -5% to +10% on major equipment (AHU’s, Fans, Pumps) and +/- 10% at terminal points (air outlets, inlets, transfer air quantities, coil water flow rates, etc.).
- B. Verify that all thermostats and other controls and the devices control as they are intended and, in the sequence, specified. Report device failures in bi-weekly reports.
- C. Where solid-state variable speed controls have been provided, adjust and mark controls for proper setting to produce the design flow.
- D. Protect read-out instruments from damage and return them in good working order to the Mechanical Contractor.

- E. Only direct-flow measurement may be used. Do not use indirect calculations, such as a heat balance or pressure drop in a heat exchanger.
- F. Balance air system minimum and maximum damper positions for correct operation at both maximum design outside air and minimum outside air, maximum and minimum return air, etc.
- G. Balance air systems in all modes of operation, including unoccupied, occupied, warm-up, cool-down, and economizer modes. Report on a room-by-room basis on the total flow of each room. Confirm flow at occupied and unoccupied modes.
- H. Provide required openings for duct traverses. Seal test holes in ducts with snap-in plugs. In addition, plugs shall be airtight type and/or sealed air tight in 1% and dust collection leak class systems. Tape is not permitted. Repair insulation where damaged. Mark insulation where readings were taken.
- I. Record the test data for each motor, fan, air system, heat exchanger, boiler, condenser, and heat pump. Apply temperature, barometric and other correction factors for non-standard conditions and record in report.
- J. Record the clean filter pressure drop across all air filters where manometric gauges have been provided at design operating cfm after final balancing.

3.4 TEST AND RECORDS

- A. Submit a separate test report for each air system outlining actual temperatures, pressure drops and flow rates at all terminal devices (e.g., supply diffusers, exhaust grilles, etc.). Compare totals to the flow measurements taken at the source (e.g., fans) and to the design parameters.
- B. In addition, record test data where applicable on the following test forms defined in Chapter 26 of the AABC National Standards or corresponding NEBB Standards.
 - 1. Air Moving Equipment Test Sheet
 - 2. Exhaust Fan Data Sheet
 - 3. Fan and Motor Pulley
 - 4. Duct Traverse Readings
 - 5. Air Distribution Test Sheet
 - 6. Air Cooled Condenser
 - 7. Cooling Coil Data
 - 8. Heating Coil Data
- C. In addition to tests and records for the foregoing equipment, tests and records are required for the following:
 - 1. Heat Transfer Coils, including nameplate data and, for both design and actual conditions, the following:
 - a. Inlet and outlet air temperature and, for cooling, both wet and dry bulb temperatures and 2-foot vertical and horizontal centers at air handlers.
 - b. Air pressure drop.
 - c. Air face velocity on 2-foot vertical and horizontal centers at air handlers
 - d. Outside air temperature.

- D. In addition to data required on National Environmental Balancing Bureau (NEBB) or AABC forms, the following additional information is required for all scheduled equipment:
 - 1. Motors - Type, frame, number, serial number, and calculated brake horsepower and efficiency at final condition.
 - 2. Fan Systems - For systems controlled by static pressure, assure by test and recording that devices, including high limit controls are calibrated to perform in accordance with Contract Documents, and provide design static pressure at the most demanding location. Furnish and coordinate static pressure setpoint of controls, as applicable, with Controls Contractor.

3.5 TESTING AND BALANCING REPORTS

- A. Submit preliminary and final testing and balancing reports for approval.
- B. Arrange recorded data by system, using the appropriate designations as established in the Contract Documents. Submit six signed, bound and indexed copies of both preliminary and final reports per building to the Owner's Representative.
- C. Where actual measurements recorded for the final balance show deviation of more than the specified tolerance from the design, and the deviation cannot be corrected by balancing with the installed layout and elements, note this deviation in the final report with recommendations for corrective action.
- D. In those cases, where recorded data can be reasonably interpreted to be inaccurate, inconsistent or erroneous, the Owner's Representative may request additional testing and balancing. The Testing and Balancing Contractor shall, at no additional cost to the Owner, perform such re-testing and re-balancing as directed by and in the presence of the Owner's Representative.
- E. Where, in the opinion of the Testing and Balancing Contractor, there is excessive vibration, movement or noise from any piece of equipment, ductwork, or piping, these conditions should be noted in the final report with recommendations for corrective action.

END OF SECTION 230594

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SECTION 230700 - HVAC INSULATION

PART 1: GENERAL

1.1 RELATED DOCUMENTS AND RELATED WORK SPECIFIED ELSEWHERE:

A. Related Documents

1. Drawings, Standard General Conditions of the Construction Contract, including Supplementary General Conditions, Division-01 Specification sections, other Division 23 specification sections, and Division 26 specifications apply to work of this section.

1.2 RATING

- A. All insulation systems, including jackets and adhesives shall be U.L. rated and FM approved. All insulation for indoor use shall have a maximum permanent flame spread rating of 25 or less and a smoke developed rating of 50 or less, as tested by ASTM E 84 (NFPA 255) method. Insulation in mechanical rooms shall have a maximum permanent flame spread rating of 25 or less and a smoke developed rating of 55 or less, as tested by ASTM E 84. Outdoor mechanical insulation may have flame spread index of 75 and smoke developed index of 150. Submit smoke and flame ratings for every material proposed for use.

1.3 SCOPE

A. Furnish and install insulation for the following:

1. Exposed mechanical equipment not pre-insulated by manufacturer that contains heated/cooled air.
2. Refrigerant suction piping.
3. All supply air ductwork.
4. Return ducts in unconditioned spaces (ceiling spaces, duct chases, mechanical rooms, outdoors, etc.).
5. Outside air ductwork.
6. Exhaust and relief ductwork where noted on the drawings.

1.4 QUALITY ASSURANCE

- A. Insulation shall be installed by a contractor who specialized in the mechanical insulation trade and worked on projects of similar size and complexity over the past five years.
- B. Insulation contractor shall be member of either the National Insulation Association (NIA) or the Southeastern Insulation Contractors Association (SEICA).

1.5 SUBMITTALS

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

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

PART 2: PRODUCTS

2.1 DUCT INSULATION

A. Mineral Fiber Blanket Insulation:

1. Manufacturer: Subject to compliance with the requirements, provide products from one of the following manufacturers:
 - a. Knauff
 - b. Johns Manville
 - c. Owens Corning
 - d. Certainteed
2. Material: Mineral or glass fiber, duct wrap 1 lb. density with FSK facing complying with ASTM C1290. Maximum K-factor of .31 at 75°F. Jacket shall be FSK aluminum foil reinforced with fiber glass yarn and laminated to fire resistant kraft paper, secured with UL listed pressure sensitive tape and outward clinch expanding staples and vapor barrier mastic.

B. Mineral Fiber Board Insulation:

1. Manufacturer: Subject to compliance with the requirements, provide products from one of the following manufacturers:
 - a. Knauff
 - b. Johns Manville
 - c. Owens Corning
 - d. Certainteed
2. Material: Mineral or glass fibers bonded with thermosetting resin complying with ASTM C612, Type I. 3 lb. density with maximum K-factor of 0.23 at 75°F mean temperature. Jacket shall be FSK aluminum foil reinforced with fiber glass yarn and laminated to fire resistant kraft paper, secured with UL listed pressure sensitive tape and outward clinch expanding staples and vapor barrier mastic.

C. Mineral Fiber Acoustic Liner:

1. Manufacturer: Subject to compliance with the requirements, provide products from one of the following manufacturers:
 - a. Knauff
 - b. Johns Manville
 - c. Owens Corning
 - d. Certainteed

2. Material: Mineral or glass fibers bonded with thermosetting resin complying with ASTM C1071. Made from inorganic glass fiber, min. NRC 0.85, 1-inch thick, minimum R-value of 4.0.
3. The air stream surface shall have a 100% coverage coating of acrylic polymer formulated with an immobilized EPA registered anti-microbial agent proven resistant to microbial growth as determined by ASTM G21 and G22.

2.2 PIPE INSULATION

A. Flexible Elastomeric Pipe Insulation:

1. Manufacturer: Subject to compliance with the requirements, provide products from one of the following manufacturers:
 - a. Armacell AP Armaflex
 - b. Aeroflex USA
 - c. K-flex USA
 - d. Nomaco FlexTherm
2. Material: Closed cell pre-formed flexible elastomeric foam insulation. Comply with ASTM C 534 with maximum thermal conductivity (k value) of 0.28 at 75 degrees F.
3. Fittings, valves, and piping components Sleeve type fitting covers and miter cut tubular form.
4. Insulation Adhesive – As recommended by manufacturer.

2.3 FIELD APPLIED JACKETS

A. Where required, the following jackets shall be applied in addition to the insulation jacket specified above.

1. PVC fitting covers and jacketing, .030" (.3 mm) thickness of white, gloss finish, weatherable grade, UV resistant, PVC material. Flame spread/smoke developed of 25/50 per ASTM-E84. Install per manufacturer's specification.
 - a. Fitting covers shall be shaped to exact fit. Longitudinal seam shall lap over from above to drain rain water overlap.
 - b. Attach with weld adhesive product provided by the jacket manufacturer. Provide bands as required and where requested.
 - c. Manufacturers: John Manville Zestar 300, Owens Corning Speeline or Knauf PVC Jacketing Fitting Covers.
2. Aluminum Jacket: 0.016-inch-thick sheet, embossed finish, with longitudinal slip joints and 2 inch laps, die shaped fitting covers with factory attached protective liner.

2.4 HEAT TRACE TAPE

- ### A. Self regulating type with 16 AWG nickel-plated copper bus wires, semi-conductive self-limiting matrix, and cross-linked polyolefin insulating jacket.

- B. Provide 6 watts per foot for pipe sizes up to 4", 8 watts per foot for pipe sizes 5" through 8", and 12 watts per foot for pipe sizes above 8".
- C. Heat tape shall be hard wired to the heat trace circuit through an ambient thermostat. The thermostat shall have an adjustable set point between 15°F and 140°F. The enclosure shall be NEMA 4X coated cast aluminum with stainless steel hardware. The switch shall be rated for 480 Vac, 22 A. The stainless steel sensor assembly shall be permanently mounted to the enclosure. The unit shall be UL Listed and CSA certified for nonhazardous locations. This description is specifically for Model AMC-1A by Raychem. Thermostats for other manufacturer's systems shall be comparably adjustable, rugged, listed and certified. Convenience or service outlets shall not be used for heat tape.
- D. All components shall be installed as a system from the same manufacturer.
- E. Manufacturer: Raychem XL, Thermon FLX, Chromalox or approved equal.

PART 3: EXECUTION

3.1 GENERAL REQUIREMENTS

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

3.2 DUCT INSULATION SHALL BE APPLIED AS FOLLOWS:

Area	Duct System (including plenums)	Insulation	Thickness	Jacket
Mechanical Equipment Rooms	Single wall supply and outside air	Mineral Fiber Board	2"	None
Concealed Interior	Double wall or single wall supply ducts with 1" acoustic liner	Mineral Fiber Blanket	1"	None
Concealed Interior	Single wall supply and outside air	Mineral Fiber Blanket	2"	None
Exterior	Supply, Return, Relief	Mineral Fiber Board	2"	Aluminum
Where noted on the drawings	Supply, Return, Relief, Transfer	Acoustic Liner	1"	N/A

3.3 PIPE INSULATION SHALL BE APPLIED AS FOLLOWS:

Area	Pipe System	Insulation	Thickness	Jacket
Exterior	Condensate drain piping	Flexible Elastomeric	2"	Corrugated Aluminum
Interior and Mech Room	Condensate drain piping	Flexible Elastomeric	1"	PVC
Interior Exposed	Refrigerant suction piping < 1"Ø	Flexible Elastomeric	3/4"	PVC
Interior Exposed	Refrigerant suction piping ≥ 1" Ø	Flexible Elastomeric	1"	PVC
Interior Concealed	Refrigerant suction piping < 1"Ø	Flexible Elastomeric	3/4"	None
Interior Concealed	Refrigerant suction piping ≥ 1" Ø	Flexible Elastomeric	1"	None
Exterior	Refrigerant suction piping < 1"Ø	Flexible Elastomeric	3/4"	Corrugated Aluminum
Exterior	Refrigerant suction piping ≥ 1" Ø	Flexible Elastomeric	1"	Corrugated Aluminum

3.4 SPECIFIC REQUIREMENTS

A. Mineral Fiber Blanket Insulation:

1. Mineral fiber blanket insulation shall be applied over clean, dry sheet metal duct. Before applying the insulation, all joints and seams shall be sealed air tight. Duct wrap shall be installed to allow maximum fullness at corners. Minimum thickness at corners is one inch. Insulation shall be butted tightly at joints and vapor barrier facing shall be overlapped at minimum of 2 inches. Insulation shall be butted tightly at joints and vapor barrier facing shall be overlapped at minimum of 2 inches. Insulation should be removed from lap prior to stapling. All seams shall be stapled approximately 6 inches on center with outward clinching staples, then sealed with a foil vapor barrier tape, or vapor barrier mastic. Where ducts are over 24 inches in width, the duct wrap shall be additionally secured to the bottom of rectangular ducts with mechanical fasteners spaced on 18-inch centers (maximum), to prevent sagging of insulation. Seal penetrations so as to provide a vapor-tight system.

B. Mineral Fiber Acoustic Liner.

1. Tape all edges and joints of insulation and protect leading edges and joints of insulation by metal strips. Duct size shall increase 2 inches in each direction where insulation is installed inside of duct.
2. Coated duct liner shall be cut to assure overlapped and compressed longitudinal corner joints. Apply liner with coated surface facing the air stream and adhere with 100% coverage of fire-retardant adhesive. Coat all exposed leading edges and all transverse joints with fire-retardant adhesive. The liner shall be additionally secured with mechanical fasteners which shall compress the duct liner sufficiently to hold it firmly in place as follows:

- a. Velocities to 2000 FPM: Fasteners shall start within 3 inches of the upstream transverse edge of liner and 3 inches from o.c. around the perimeter of the duct, except that they may be a maximum of 12 inches from a corner break. Elsewhere they shall be a maximum of 18 inches o.c. except that they be not more than 6 inches from a longitudinal joint of liner nor 12 inches from a corner break. Coat all exposed joints and edges of transverse joints with a fire-retardant adhesive.
 - b. Velocities from 2000 to 4000 FPM: Fasteners shall start with 3 inches of the upstream transverse edges of the liner and 3 inches from the longitudinal joints and shall be placed at a maximum of 6 inches o.c. around the perimeter of the duct, except where they shall be a maximum of 6 inches from a corner break. Elsewhere they shall be a maximum of 16 inches o.c. except that they shall be placed not more than 6 inches from a longitudinal joint of the liner nor 12 inches from a corner break. In addition to adhesive edge coating of transverse joints, any longitudinal joints shall be similarly coated with adhesive.
- C. Insulation shall be installed according to manufacturer recommendations. Insulation over the expansion joint and the flexible section shall be loose and of adequate length to permit the movement of duct.
- D. Flexible Elastomeric Pipe Insulation:
- 1. Installation - Butt edges tightly, secure with elastomeric foam adhesive as recommended by insulation manufacturer.
 - 2. Heat Trace Tape shall be wired through a remote bulb thermostat monitoring ambient temperature set at 40oF.
- 3.5 DO NOT INSULATE
- A. Vibration eliminators.
 - B. Equipment nameplates.

END OF SECTION 230700

SECTION 230900 - BUILDING MANAGEMENT SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Building Management System (BMS), utilizing direct digital controls.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. All work of this Division shall comply with the requirements of the Drawings, Standard General Conditions of the Construction Contract, including Supplementary General Conditions and Division 1 Specification Sections.
- B. Section 23 05 30 – Electrical Provisions for Mechanical Work
- C. Division 26 - Electrical
- D. Products Supplied but Not Installed Under This Section:
 - 1. Automatic control dampers, where not integral to equipment. Refer to Section 233100 – Ductwork and Dampers.
 - 2. In-line meters (water).
- E. Products Installed but Not Supplied Under This Section:
 - 1. None.
- F. Products Not Furnished or Installed but Integrated with the Work of This Section:
 - 1. Smoke detectors (through alarm relay contacts).
- G. Work Required Under Other Divisions Related to This Section:
 - 1. Power wiring to line side of motor starters, disconnects or variable frequency drives.
 - 2. Provision and wiring of smoke detectors and other devices relating to fire alarm system.
 - 3. Campus LAN (Ethernet) connection adjacent to JACE network management controller.

1.3 SYSTEM DESCRIPTION

- A. Scope: Furnish all labor, materials and equipment necessary for a complete and operating Building Management System (BMS), utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are diagrammatic only. All controllers furnished in this section shall communicate on a peer-to-peer bus over a LonWorks open protocol bus. All controllers on the LonWorks bus shall be LonMark certified.
 - 1. The intent of this specification is to provide a system that is consistent with BMS systems throughout the owner's facilities running the Niagara 4 Framework.
 - 2. System architecture shall fully support a multi-vendor environment and be able to integrate third party systems via existing vendor protocols including, as a minimum, LonWorks,

- BACnet, IP Based, and MODBUS.
3. The BMS shall be stand-alone with a building control unit, BAS LAN and one (1) ethernet connection to the university wide area network. The system shall use the existing campus Ethernet Network for data communication between the building and the Web Server.
 4. System architecture shall provide secure Web access using any of the current versions of Microsoft Internet Explorer, Mozilla Firefox, or Google Chrome browsers from any computer on the owner's LAN.
 5. All control devices, including configurable and fully programmable controllers, furnished with this Section shall be programmable directly from the Niagara 4 Workbench embedded toolset upon completion of this project. The use of configurable or programmable controllers that require additional software tools shall not be acceptable.
 6. Any control vendor that shall provide additional BMS server software shall be unacceptable. Only systems that utilize the Niagara 4 Framework shall satisfy the requirements of this section.
 7. The BMS server shall host all graphic files for the control system. All graphics and navigation schemes for this project shall match those that are on the existing campus NiagaraAX or Niagara 4 Framework server.
 8. Owner shall receive all Administrator level login and passwords for engineering toolset at first training session. The Owner shall have full licensing and full access rights for all network management, operating system server, engineering and programming software required for the ongoing maintenance and operation of the BMS.
 9. OPEN NIC STATEMENTS - All Niagara 4 software licenses shall have the following NiCS: "accept.station.in=*"; "accept.station.out=*" and "accept.wb.in=*" and "accept.wb.out=*". All open NIC statements shall follow Niagara Open NIC specifications.
 10. All JACE hardware licenses and certificates shall be stored on local MicroSD memory card employing encrypted "safe boot" technology.
 11. All JACE's provided as part of this project shall be the appropriate JACE-8000 model licensed with all necessary drivers.
 12. Approved Manufacturers: Honeywell, TAC I/A Series, Distech
 13. Approved Installation Contractors: Engineered Control Solutions, Schneider Electric CMS Controls

1.4 SPECIFICATION NOMENCLATURE

A. Acronyms used in this specification are as follows:

1. Actuator: Control device that opens or closes valve or damper in response to control signal.
2. AI: Analog Input.
3. AO: Analog Output.
4. Analog: Continuously variable state over stated range of values.
5. BMS: Building Management System.
6. DDC: Direct Digital Control.
7. Discrete: Binary or digital state.
8. DI: Discrete Input.
9. DO: Discrete Output.
10. FC: Fail Closed position of control device or actuator. Device moves to closed position on loss of control signal or energy source.
11. FO: Fail open (position of control device or actuator). Device moves to open position on loss of control signal or energy source.
12. GUI: Graphical User Interface.

13. HVAC: Heating, Ventilating and Air Conditioning.
14. IDC: Interoperable Digital Controller.
15. ILC: Interoperable Lon Controller.
16. LAN: Local Area Network.
17. Modulating: Movement of a control device through an entire range of values, proportional to an infinitely variable input value.
18. Motorized: Control device with actuator.
19. NAC: Network Area Controller.
20. NC: Normally closed position of switch after control signal is removed or normally closed position of manually operated valves or dampers.
21. NO: Normally open position of switch after control signal is removed; or the open position of a controlled valve or damper after the control signal is removed; or the usual position of a manually operated valve.
22. OSS: Operating System Server, host for system graphics, alarms, trends, etc.
23. Operator: Same as actuator.
24. PC: Personal Computer.
25. Peer-to-Peer: Mode of communication between controllers in which each device connected to network has equal status and each shares its database values with all other devices connected to network.
26. P: Proportional control; control mode with continuous linear relationship between observed input signal and final controlled output element.
27. PI: Proportional-Integral control, control mode with continuous proportional output plus additional change in output based on both amount and duration of change in controller variable (reset control).
28. PICS: BACnet Product Interoperability Compliance Statement.
29. PID: Proportional-Integral-Derivative control, control mode with continuous correction of final controller output element versus input signal based on proportional error, its time history (reset) and rate at which it's changing (derivative).
30. Point: Analog or discrete instrument with addressable database value.
31. WAN: Wide Area Network.

1.5 SUBMITTALS

- A. Submit under provisions of Division 01.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 1. Preparation instructions and recommendations.
 2. Storage and handling requirements and recommendations.
 3. Installation methods.
- C. Submit documentation of contractor qualifications, including those indicated in "Quality Assurance" if requested by the A-E.
- D. One (1) electronic copy of shop drawings of the entire control system shall be submitted and shall consist of a complete list of equipment and materials, including manufacturers' catalog data sheets and installation instructions. Submit in printed electronic format. Samples of written Controller Checkout Sheets and Performance Verification Procedures for applications similar in scope shall be included for approval.
- E. Shop drawings shall also contain complete wiring and schematic diagrams, sequences of operation,

control system bus layout and any other details required to demonstrate that the system has been coordinated and will properly function as a system. Terminal identification for all control wiring shall be shown on the shop drawings.

- F. Upon completion of the work, provide 3 complete sets of 'as-built' drawings and other project-specific documentation in 3-ring hard-backed binders and one electronic copy.
- G. Any deviations from these specifications or the work indicated on the drawings shall be clearly identified in the Submittals.

1.6 QUALITY ASSURANCE

- A. The Control System Contractor shall have a full service DDC office within 75 miles of the job site. This office shall be staffed with applications engineers, software engineers and field technicians. The Control System Contractor shall be staffed with a minimum of ten (10) Niagara 4 certified software engineers and/or technicians. The Control System Contractor shall maintain parts inventory and shall have all testing and diagnostic equipment necessary to support this work, as well as staff trained in the use of this equipment.
- B. Single Source Responsibility of Supplier: The Control System Contractor shall be responsible for the complete installation and proper operation of the control system. The Control System Contractor shall exclusively be in the regular and customary business of design, installation and service of computerized building management systems similar in size and complexity to the system specified. The Control System Contractor shall be the manufacturer of the primary DDC system components or shall have been the authorized representative for the primary DDC components manufacturer for at least 10 years. All control panels shall be assembled by the Control System Contractor in a UL-Certified 508A panel shop. Control panels shall be assembled such that all necessary I/O points are pre-wired to terminal blocks. Wire ducts shall be installed within the panel as needed to accommodate field wiring.
- C. Equipment and Materials: Equipment and materials shall be cataloged products of manufacturers regularly engaged in the production and installation of HVAC control systems. Products shall be manufacturer's latest standard design and have been tested and proven in actual use.

1.7 SOFTWARE OWNERSHIP

- A. The Owner shall have full ownership and full access rights for all network management, operating system server, engineering and programming software required for the ongoing maintenance and operation of the BMS.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Maintain integrity of shipping cartons for each piece of equipment and control device through shipping, storage and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.

1.9 JOB CONDITIONS

- A. Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to ensure that the Work will be carried out in an orderly fashion. It shall be this Contractor's responsibility to check the Contract Documents for possible conflicts between his Work and that

of other crafts in equipment location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers and structural and architectural features.

1.10 SEQUENCING

- A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

PART 2 PRODUCTS

2.1 GENERAL

- A. The Building Management System (BMS) shall be comprised of a network of interoperable, stand-alone digital controllers, a network area controller, graphics and programming and other control devices for a complete system as specified herein.
- B. The installed system shall provide secure strong password access to all features, functions and data contained in the overall BMS.

2.2 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURE

- A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system utilizing the LonWorks technology communication protocol in one open, interoperable system.
- B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. Physical connection of any BACnet control equipment, such as chillers, shall be via Ethernet or IP.
- C. All components and controllers supplied under this contract shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.
- D. The supplied system shall incorporate the ability to access all data using HTML5 enabled browsers without requiring proprietary operator interface and configuration programs or browser plug-ins. An Open Database Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on the Operating System Server located in the Facilities Office on the LAN. Systems requiring proprietary database and user interface programs shall not be acceptable.
- E. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable.
 - 1. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.
 - 2. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

2.3 BAS SERVER HARDWARE (Provided by Owner)

A. Minimum Computer Configuration (Hardware Independent).

1. Central Server. Owner shall provide a dedicated BAS server with configuration that includes the following components as a minimum:
2. Processor: Intel Xeon CPU E5-2640 x64 (or better), compatible with dual- and quad-core processors.
3. Memory: 8 GB or more.
4. Hard Drive: 80 GB minimum, more recommended depending on archiving requirements.
5. Display: Video card and monitor capable of displaying 1024 x 768 pixel resolution or greater.
6. Network Support: Ethernet adapter (10/100 Mb with RJ-45 connector).
7. Connectivity: Full-time high-speed ISP connection recommended for remote site access (i.e. T1, ADSL, cable modem).

B. Standard Client: The thin-client Web Browser BAS GUI shall be Microsoft Internet Explorer (10.0 or later) running on Microsoft 7+. No special software shall be required to be installed on the PCs used to access the BAS via a web browser.

2.4 SYSTEM NETWORK CONTROLLER (SNC)

- ### A. These controllers are designed to manage communications between the programmable equipment controllers (PEC), application specific controllers (ASC) and advanced unitary controllers (AUC) which are connected to its communications trunks, manage communications between itself and other system network controllers (SNC) and with any operator workstations (OWS) that are part of the BAS, and perform control and operating strategies for the system based on information from any controller connected to the BAS.
- ### B. The controllers shall be fully programmable to meet the unique requirements of the facility it shall control.
- ### C. The controllers shall be capable of peer-to-peer communications with other SNC's and with any OWS connected to the BAS, whether the OWS is directly connected, connected via cellular modem or connected via the Internet.
- ### D. The communication protocols utilized for peer-to-peer communications between SNC's will be Niagara 4 Fox, BACnet TCP/IP and SNMP. Use of a proprietary communication protocol for peer-to-peer communications between SNC's is not allowed.
- ### E. The SNC shall employ a device count capacity license model that supports expansion capabilities.
- ### F. The SNC shall be enabled to support and shall be licensed with the following Open protocol drivers (client and server) by default:
1. BACnet
 2. Lon
 3. MODBUS
 4. SNMP
 5. KNX

- G. The SNC shall be capable of executing application control programs to provide:
1. Calendar functions.
 2. Scheduling.
 3. Trending.
 4. Alarm monitoring and routing.
 5. Time synchronization.
 6. Integration of LonWorks, BACnet, and MODBUS controller data.
 7. Network management functions for all SNC, PEC and ASC based devices.
- H. The SNC shall provide the following hardware features as a minimum:
1. Two 10/100 Mbps Ethernet ports.
 2. Two Isolated RS-485 ports with biasing switches.
 3. 1 GB RAM
 4. 4 GB Flash Total Storage / 2 GB User Storage
 5. Wi-Fi (Client or WAP)
 6. USB Flash Drive
 7. High Speed Field Bus Expansion
 8. -20-60°C Ambient Operating Temperature
 9. Integrated 24 VAC/DC Global Power Supply
 10. MicroSD Memory Card Employing Encrypted Safe Boot Technology
- I. The SNC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users.
- J. The SNC shall provide alarm recognition, storage, routing, management and analysis to supplement distributed capabilities of equipment or application specific controllers.
- K. The SNC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via cellular modem, or wide-area network.
1. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but not limited to:
 - a. Alarm.
 - b. Return to normal.
 - c. To default.
 2. Alarms shall be annunciated in any of the following manners as defined by the user:
 - a. Screen message text.
 - b. Email of complete alarm message to multiple recipients.
 - c. Pagers via paging services that initiate a page on receipt of email message.
 - d. Graphics with flashing alarm object(s).
 3. The following shall be recorded by the SNC for each alarm (at a minimum):
 - a. Time and date.
 - b. Equipment (air handler #, access way, etc.).
 - c. Acknowledge time, date, and user who issued acknowledgement.

4. Alarms classes shall be created in the local station to match N4 Supervisor class naming in the following manner with same naming for priority routing and annunciation. (listed in order of priority from highest to lowest)
 - a. CriticalAlarms (Priority 1)
 - b. HighPriority (Priority 2)
 - c. SpaceTempAlarms (Priority 3)
 - d. GeneratorAlarms (Priority 3) (if required)
 - e. PlumbersAlarms (Priority 3) (if required)
 - f. MidPriority (Priority 4)
 - g. LowPriority (Priority 5)
 - h. PingAlarms (Priority 6)*Back to normal state (Priority 7)*
5. All alarm classes in the local station shall be directed to the N4 station recipient for routing. The Supervisors "SupervisorConsole" should be added to a Px view accessible via a hyperlink with a filter applied to show only the selected buildings alarms on the appropriate building's graphics alarm page.
 - a. Time Stamp
 - b. Source
 - c. Source State
 - d. Alarm State
 - e. Priority
 - f. Alarm Class
 - g. Ack or Clear Action link
- L. Programming software and all controller "Setup Wizards" shall be embedded into the SNC.
- M. The SNC shall support the following security functions.
 1. Module code signing to verify the author of programming tool and confirm that the code has not been altered or corrupted.
 2. Role-Based Access Control (RBAC) for managing user roles and permissions.
 3. Require users to use strong credentials.
 4. Data in Motion and Sensitive Data at Rest be encrypted.
 5. LDAP and Kerberos integration of access management.
- N. The SNC shall support the following data modeling structures to utilize Search; Hierarchy; Template; and Permission functionality:
 1. Metadata: Descriptive tags to define the structure of properties.
 2. Tagging: Process to apply metadata to components
 3. Tag Dictionary
- O. The SNC shall employ template functionality. Templates are a containerized set of configured data tags, graphics, histories, alarms... that are set to be deployed as a unit based upon manufacturer's controller and relationships. All lower level communicating controllers (PEC, AVAV, CVAV, VFD) shall have an associated template file for reuse on future project additions.
- P. The SNC point naming shall follow a standard as set for a standardized naming convention. This

naming standard shall be applied to the SNC as well as the BAS Server Supervisor for all points related to setpoints, monitoring points, trending, alarming, and graphics.

- Q. The SNC shall be provided with a 1 Year Software Maintenance license. Labor to implement not included.

2.5 BUILDING AUTOMATION SYSTEM CONTROLLERS

- A. HVAC local programmable and configurable controller's communications protocol (AHU, VAV, and plant) shall be accomplished using LonMark, BACnet, or IP based devices. The controller platform shall provide options and advanced system functions, programmable and configurable using Niagara 4 Framework, that allow standard and customizable control solutions required in executing the "Sequence of Operation".
1. Programmable Equipment Controllers - a controller designed for more complex sequences of operations such as built up AHU's, central plant operations, electrical monitoring, and control and management for chillers, boilers and generators. The PECs are to allow for the flexibility of custom control programming to meet the needed sequences of operation. PEC's shall be selected based upon I/O requirements. Additional I/O may be added via expansion modules.
 - a. All PECs shall be application programmable and shall at all times maintain their certification. All control sequences within or programmed into the PEC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.
 - b. The PEC shall provide LED indication of communication and controller performance to the technician, without cover removal.
 - c. PEC's shall have mixture of I/O including dry contact digital inputs, universal inputs (configurable as 0-10V, 0-10,000 ohm or, 20K NTC), analog outputs (4-20mA), and digital outputs (24 VAC TRIAC or relay).
 2. Configurable Constant Volume AHU Controller (CVAHU) - the configurable constant volume AHU controller shall be designed specifically for single zone unitary AHU control –temperature, humidity, complex CO₂, occupancy, and emergency control. Equipment includes: unitary air handling units, fan coil units, blower coil units, unit ventilators, and heat pumps.
 - a. The CVAHU controller shall be application specific configuration and shall at all times maintain their certification. All control sequences within or programmed into the CVAHU controller shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.
 - b. The CVAHU controller shall provide LED indication of communication and controller performance to the technician, without cover removal.
 - c. CVAHU controllers shall have mixture of I/O including dry contact digital inputs, universal inputs (configurable as 0-10V, 0-10,000 ohm or, 20K NTC), analog outputs (4-20mA), and digital outputs (24 VAC TRIAC).

2.6 OTHER CONTROL SYSTEM HARDWARE

- A. Utility metering devices, (water and electric) shall be non-pulse devices with non-volatile memory communicated directly to a gateway such as SCADAmetrics Ethermeter, Onicon D-100, or kW switchgear meters which will be communicated to the building and supervisor Niagara system.
- B. HVAC local non-programmable and non-configurable integration devices, (boilers, VFD's, and utility meters) shall use LonMark, BACnet, Modbus, or IP based devices to communicate.
- C. Motorized control dampers that will not be integral to the equipment shall be furnished by the Control System Contractor. Control damper frames shall be constructed of galvanized steel, formed into channels and welded or riveted. Dampers shall be galvanized, with nylon bearings. Blade edge seals shall be vinyl. Blade edge and tip seals shall be included for all dampers. Blades shall be 16-gauge minimum and 6 inches wide maximum and frame shall be of welded channel iron. Damper leakage shall not exceed 10 CFM per square foot, at 1.5 inches water gauge static pressure.
- D. Control damper actuators shall be furnished by the Control System Contractor. Two-position or proportional electric actuators shall be direct-mount type sized to provide a minimum of 5 in-lb torque per square foot of damper area. Damper actuators shall be spring return type. Operators shall be heavy-duty electronic type for positioning automatic dampers in response to a control signal. Motor shall be of sufficient size to operate damper positively and smoothly to obtain correct sequence as indicated. All applications requiring proportional operation shall utilize truly proportional electric actuators.
- E. Wall Mount Room Temperature sensors: Each room temperature sensor shall provide temperature indication to the digital controller, provide the capability for a software-limited occupant set point adjustment (warmer-cooler slider bar or switch) and limited operation override capability. Room Temperature Sensors shall be 20,000-ohm thermistor type with a temperature range of -40 to 140 degrees F (-38 to 60 degrees C). The sensor shall be complete with a decorative cover and suitable for mounting over a standard electrical utility box. These devices shall have an accuracy of 0.5 degrees F (.024 degrees C) over the entire range.
- F. Duct-mounted and Outside Air Temperature Sensors: 20,000-ohm thermistor temperature sensors with an accuracy of ± 0.2 degrees C. Outside air sensors shall include an integral sun shield. Duct-mounted sensors shall have an insertion measuring probe of a length appropriate for the duct size, with a temperature range of -40 to 160 degrees F (-38 to 71 degrees C) The sensor shall include a utility box and a gasket to prevent air leakage and vibration noise. For all mixed air and preheat air applications, install bendable averaging duct sensors with a minimum 8 feet (2438 mm) long sensor element. These devices shall have accuracy of 0.5 degrees F (.024 degrees C) over the entire range.
- G. Humidity sensors shall be thin-film capacitive type sensor with on-board nonvolatile memory, accuracy to plus or minus two percent (2%) at 0 to 90% RH, 12 - 30 VDC input voltage, analog output (0 - 10 VDC or 4 - 20mA output). Operating range shall be 0 to 100% RH and 32 to 140 degrees F (0 to 60 degrees C). Sensors shall be selected for wall, duct or outdoor type installation as appropriate. Honeywell is basis of design.
- H. Carbon Dioxide Sensors (CO₂): Sensors shall utilize Non-dispersive infrared technology (N.D.I.R.), repeatable to plus or minus 20 PPM. Sensor range shall be 0 - 2000 PPM. Accuracy shall be plus or minus five percent (5%) or 75 PPM, whichever is greater. Response shall be less than one minute. Input voltage shall be 20 to 30 VAC or DC. Output shall be 0 - 10 VDC. Sensor shall be wall or duct mounted type, as appropriate for the application, housed in a high impact

plastic enclosure.

- I. Current Sensitive Switches: Solid state, split core current switch that operates when the current level (sensed by the internal current transformer) exceeds the adjustable trip point. Current switch to include an integral LED for indication of trip condition and a current level below trip set point.
- J. Differential Analog (duct) Static Pressure Transmitters Provide a pressure transmitter with integral capacitance type sensing and solid-state circuitry. Accuracy shall be plus or minus 1% of full range; range shall be selected for the specific application. Provide zero and span adjustment capability. Device shall have integral static pickup tube.
- K. Differential Air Pressure Switches: Provide SPDT type, UL-approved, and selected for the appropriate operating range where applied. Switches shall have adjustable set points and barbed pressure tips.
- L. Temperature Control Panels: Furnish temperature control panels of code gauge steel with locking doors for mounting all devices as shown. All electrical devices within a control panel shall be factory wired. Control panel shall be assembled by the BMS in a UL-Certified 508A panel shop. A complete set of 'as-built' control drawings (relating to the controls within that panel) shall be furnished within each control panel.
- M. Pipe and Duct Temperature sensing elements: 20,000-ohm thermistor temperature sensors with and accuracy of $\pm 1\%$ accuracy. Their range shall be -5 to 250 degrees F (-20 to 121 degrees C). Limited range sensors shall be acceptable provided they are capable of sensing the range expected for the point at the specified accuracy. Thermal wells with heat conductive gel shall be included.
- N. Low Air Temperature Sensors: Provide SPST type switch, with 15 to 55 degrees F (-9 to 13 degrees C), range, vapor-charged temperature sensor. Honeywell model L482A, or approved equivalent.
- O. Relays: Start/stop relay model shall provide either momentary or maintained switching action as appropriate for the motor being started. All relays shall be plugged in, interchangeable, mounted on a sub base and wired to numbered terminals strips. Relays installed in panels shall all be DPDT with indicating lamp. Relays installed outside of controlled devices shall be enclosed in a NEMA enclosure suitable for the location. Relays shall be labeled with UR symbol. RIB-style relays are acceptable for remote enable/disable.
- P. Emergency Stop Switches: Provide toggle-type switch with normally-closed contact. Switch shall be labeled "AIR HANDLER EMERGENCY SHUTOFF, NORMAL - OFF".
- Q. Transducers: Differential pressure transducers shall be electronic with a 4-20 mA output signal compatible to the Direct Digital Controller. Wetted parts shall be stainless steel. Unit shall be designed to operate in the pressure ranges involved.
- R. Control Power Transformers: Provide step-down transformers for all DDC controllers and devices as required. Transformers shall be sized for the load, but shall be sized for 50 watts, minimum. Transformers shall be UL listed Class 2 type, for 120 VAC/24 VAC operation.
- S. Line voltage protection: All DDC system control panels that are powered by 120 VAC circuits shall be provided with surge protection. This protection is in addition to any internal protection provided by the manufacturer. The protection shall meet UL, ULC 1449, IEEE C62.41B. A grounding conductor, (minimum 12 AWG), shall be brought to each control panel.

- T. Lon Bus Surge Protectors: A Lon Bus Surge Protector, DITEK model # DTK-2MHLP24BWB or equivalent shall be installed on the Lon bus when it leaves and enters a building.
- U. Ethernet Port Surge Protector: An Ethernet Surge protector shall be installed similar to the Honeywell 14507678-004 or comparable.

V. Domestic Water Meters:

Building meters: Neptune

1.5 inches and below shall be positive displacement type with matching strainer.

2 inches and above shall be compound type meter with matching strainer.

Meter Register: Neptune E-Coder register w/ the potted cable. (The R900i register is NOT compatible, since it does not feature a connection wire.)

Meter Gateway: Scadаметrics Ethermeter <http://www.scadametries.com/> The gateway device shall directly interrogate with the meter register and shall calculate and relay the following parameters to the BMS: Totalized Volume, Instantaneous Flowrate.

2.7 BAS SERVER & WEB BROWSER GUI - SYSTEM OVERVIEW

- A. The BAS Contractor shall provide system software based on server/thin-client architecture, designed around the open standards of web technology. The BAS server shall communicate using Ethernet and TCP. Server shall be accessed using a web browser over Owner intranet and remotely over the Internet.
- B. The intent of the thin-client architecture is to provide the operator(s) complete access to the BAS system via a web browser. The thin-client web browser Graphical User Interface (GUI) shall be browser and operating system agnostic, meaning it will support HTML5 enabled browsers without requiring proprietary operator interface and configuration programs or browser plug-ins. Microsoft, Firefox, and Chrome browsers (current released versions), and Windows as well as non-Windows operating systems.
- C. The BAS server software shall support at least the following server platforms (Windows 7, 8.1, Server 12). The BAS server software shall be developed and tested by the manufacturer of the system stand-alone controllers and network controllers/routers.
- D. The web browser GUI shall provide a completely interactive user interface and shall provide a HTML5 experience that supports the following features as a minimum:
 - 1. Trending.
 - 2. Scheduling.
 - 3. Electrical demand limiting.
 - 4. Duty Cycling.
 - 5. Downloading Memory to field devices.
 - 6. Real time 'live' Graphic Programs.
 - 7. Tree Navigation.
 - 8. Parameter change of properties.
 - 9. Set point adjustments.

10. Alarm / event information.
11. Configuration of operators.
12. Execution of global commands.
13. Add, delete, and modify graphics and displayed data.

E. Software Components: All software shall be the most current version. All software components of the BAS system software shall be provided and installed as part of this project. BAS software components shall include:

1. Server Software, Database and Web Browser Graphical User Interface.
2. 5 Year Software Maintenance license. Labor to implement not included.
3. Embedded System Configuration Utilities for future modifications to the system and controllers.
4. Embedded Graphical Programming Tools.
5. Embedded Direct Digital Control software.
6. Embedded Application Software.

F. BAS Server Database: The BAS server software shall utilize a Java Database Connectivity (JDBC) compatible database such as: MS SQL 8.0, Oracle 8i or IBM DB2. BAS systems written to Non-Standard and/or Proprietary databases are NOT acceptable.

G. Thin Client - Web Browser Based: The GUI shall be thin client or browser based and shall meet the following criteria:

1. Web Browser's for PC's: Only the current released browser (Explorer/Firefox/Chrome) will be required as the GUI and a valid connection to the server network. No installation of any custom software shall be required on the operator's GUI workstation/client. Connection shall be over an intranet or the Internet.
2. Secure Socket Layers: Communication between the Web Browser GUI and BAS server shall offer encryption using 128-bit encryption technology within Secure Socket Layers (SSL). Communication protocol shall be Hyper-Text Transfer Protocol (HTTP).

2.8 WEB BROWSER GRAPHICAL USER INTERFACE

A. Web Browser Navigation: The Thin Client web browser GUI shall provide a comprehensive user interface. Using a collection of web pages, it shall be constructed to "feel" like a single application and provide a complete and intuitive mouse/menu driven operator interface. It shall be possible to navigate through the system using a web browser to accomplish requirements of this specification. The Web Browser GUI shall (as a minimum) provide for navigation, and for display of animated graphics, schedules, alarms/events, live graphic programs, active graphic set point controls, configuration menus for operator access, reports and reporting actions for events.

B. Login: On launching the web browser and selecting the appropriate domain name or IP address, the operator shall be presented with a login page that will require a login name and strong password. Navigation in the system shall be dependent on the operator's role-based application control privileges.

C. Navigation: Navigation through the GUI shall be accomplished by clicking on the appropriate level of a navigation tree (consisting of an expandable and collapsible tree control like Microsoft's Explorer program) and/or by selecting dynamic links to other system graphics. Both the navigation tree and action pane shall be displayed simultaneously, enabling the operator to select a specific

system or equipment and view the corresponding graphic. The navigation tree shall as a minimum provide the following views: Geographic, Network, Groups and Configuration.

1. Geographic View shall display a logical geographic hierarchy of the system including cities, sites, buildings, building systems, floors, equipment and objects.
 2. Groups View shall display Scheduled Groups and custom reports.
 3. Configuration View shall display all the configuration categories (Operators, Schedule, Event, Reporting and Roles).
- D. Action Pane: The Action Pane shall provide several functional views for each subsystem specified. A functional view shall be accessed by clicking on the corresponding button:
1. Graphics: Using graphical format suitable for display in a web browser, graphics shall include aerial building/campus views, color building floorplans, equipment drawings, active graphic set point controls, web content and other valid HTML elements. The data on each graphic page shall automatically refresh.
 2. Dashboards: User customizable data using drag and drop HTML5 elements. Shall include Web Charts, Gauges, and other custom developed widgets for web browser. User shall have ability to save custom dashboards.
 3. Search: User shall have multiple options for searching data based upon Tags. Associated equipment, real time data, Properties, and Trends shall be available in result.
 4. Properties: Shall include graphic controls and text for the following: Locking or overriding objects, demand strategies, and any other valid data required for setup. Changes made to the property's pages shall require the operator to depress an 'accept/cancel' button.
 5. Schedules: Shall be used to create, modify/edit and view schedules based on the systems hierarchy (using the navigation tree).
 6. Alarms: Shall be used to view alarm information geographically (using the navigation tree), acknowledge alarms, sort alarms by category, actions and verify reporting actions.
 7. Charting: Shall be used to display associated trend and historical data, modify colors, date range, axis and scaling. User shall have ability to create HTML charts through web browser without utilizing chart builder. User shall be able to drag and drop single or multiple data points, including schedules, and apply status colors for analysis.
 8. Logic - Live Graphic Programs: Shall be used to display 'live' graphic programs of the control algorithm, (micro block programming) for the mechanical/electrical system selected in the navigation tree.
 9. Other actions such as Print, Help, Command, and Logout shall be available via a drop-down window.
- E. Color Graphics: The Web Browser GUI shall make extensive use of color in the graphic pane to communicate information related to set points and comfort. Animated gifs or .jpg, vector scalable, active set point graphic controls shall be used to enhance usability. Graphics tools used to create Web Browser graphics shall be non-proprietary and conform to the following basic criteria:
1. Display Size: The GUI workstation software shall graphically display in a minimum of 1024 by 768 pixels 24-bit True Color.
 2. General Graphic: General area maps shall show locations of controlled buildings in relation to local landmarks.
 3. Color Floor Plans: Floor plan graphics shall show heating and cooling zones throughout the buildings in a range of colors, as selected by Owner. Provide a visual display of temperature relative to their respective set points. The colors shall be updated dynamically as a zone's actual comfort condition changes.

4. Mechanical Components: Mechanical system graphics shall show the type of mechanical system components serving any zone through the use of a pictorial representation of components. Selected I/O points being controlled or monitored for each piece of equipment shall be displayed with the appropriate engineering units. Animation shall be used for rotation or moving mechanical components to enhance usability.
 5. Minimum System Color Graphics: Color graphics shall be selected and displayed via a web browser for the following:
 - a. Each piece of equipment monitored or controlled including each terminal unit.
 - b. Each building.
 - c. Each floor and zone controlled.
- F. Hierarchical Schedules: Utilizing the Navigation Tree displayed in the web browser GUI, an operator (with proper access credentials) shall be able to define a Normal, Holiday or Override schedule for an individual piece of equipment or room, or choose to apply a hierarchical schedule to the entire system, site or floor area. For example, Independence Day 'Holiday' for every level in the system would be created by clicking at the top of the geographic hierarchy defined in the Navigation Tree. No further operator intervention would be required and every control module in the system would be automatically downloaded with the 'Independence Day' Holiday. All schedules that affect the system/area/equipment highlighted in the Navigation Tree shall be shown in a summary schedule table and graph.
1. Schedules: Schedules shall comply with the LonWorks and BACnet standards, (Schedule Object, Calendar Object, Weekly Schedule property and Exception Schedule property) and shall allow events to be scheduled based on:
 - a. Types of schedule shall be Normal, Holiday or Override.
 - b. A specific date.
 - c. A range of dates.
 - d. Any combination of Month of Year (1-12, any), Week of Month (1-5, last, any), Day of Week (M-Sun, Any).
 - e. Wildcard (example, allow combinations like second Tuesday of every month).
 2. Schedule Categories: The system shall allow operators to define and edit scheduling categories (different types of "things" to be scheduled; for example, lighting, HVAC occupancy, etc.). The categories shall include name, description, icon (to display in the hierarchy tree when icon option is selected) and type of value to be scheduled.
 3. Schedule Groups: In addition to hierarchical scheduling, operators shall be able to define functional Schedule Groups, comprised of an arbitrary group of areas/rooms/equipment scattered throughout the facility and site. For example, the operator shall be able to define an 'individual tenant' group - who may occupy different areas within a building or buildings. Schedules applied to the 'tenant group' shall automatically be downloaded to control modules affecting spaces occupied by the 'tenant group'.
 4. Intelligent Scheduling: The control system shall be intelligent enough to automatically turn on any supporting equipment needed to control the environment in an occupied space. If the operator schedules an individual room in a VAV system for occupancy, for example, the control logic shall automatically turn on the VAV air handling unit, chiller, boiler and/or any other equipment required to maintain the specified comfort and environmental conditions within the room.
 5. Partial Day Exceptions: Schedule events shall be able to accommodate a time range specified by the operator (ex: board meeting from 6 pm to 9 pm overrides Normal schedule

- for conference room).
6. Schedule Summary Graph: The schedule summary graph shall clearly show Normal versus Holiday versus Override Schedules and the net operating schedule that results from all contributing schedules. Note: In case of priority conflict between schedules at the different geographic hierarchy, the schedule for the more detailed geographic level shall apply.
- G. Alarms: Alarms associated with a specific system, area, or equipment selected in the Navigation Tree, shall be displayed in the Action Pane by selecting an ' Alarms' view. Alarms, and reporting actions shall have the following capabilities:
1. Alarms View: Each Alarm shall display an Alarms Category (using a different icon for each alarm category), date/time of occurrence, current status, alarm report and a bold URL link to the associated graphic for the selected system, area or equipment. The URL link shall indicate the system location, address and other pertinent information. An operator shall easily be able to sort events, edit event templates and categories, acknowledge or force a return to normal in the Events View as specified in this section.
 2. Alarm Categories: The operator shall be able to create, edit or delete alarm categories such as HVAC, Maintenance, Fire, or Generator. An icon shall be associated with each alarm category, enabling the operator to easily sort through multiple events displayed.
 3. Alarm Templates: Alarm template shall define different types of alarms and their associated properties. As a minimum, properties shall include a reference name, verbose description, severity of alarm, acknowledgement requirements, and high/low limit and out of range information.
 4. Alarm Areas: Alarm Areas enable an operator to assign specific Alarm Categories to specific Alarm Reporting Actions. For example, it shall be possible for an operator to assign all HVAC Maintenance Alarm on the 1st floor of a building to email the technician responsible for maintenance. The Navigation Tree shall be used to setup Alarm Areas in the Graphic Pane.
 5. Alarm Time/Date Stamp: All events shall be generated at the DDC control module level and comprise the Time/Date Stamp using the standalone control module time and date.
 6. Alarm Configuration: Operators shall be able to define the type of Alarm generated per object. A 'network' view of the Navigation Tree shall expose all objects and their respective Alarm Configuration. Configuration shall include assignment of Alarm, type of Acknowledgement and notification for return to normal or fault status.
 7. Alarm Summary Counter: The view of Alarm in the Graphic Pane shall provide a numeric counter, indicating how many Alarms are active (in alarm), require acknowledgement and total number of Alarms in the BAS Server database.
 8. Alarm Auto-Deletion: Alarms that are acknowledged and closed shall be auto-deleted from the database and archived to a text file after an operator defined period.
 9. Alarm Reporting Actions: Alarm Reporting Actions specified shall be automatically launched (under certain conditions) after an Alarm is received by the BAS server software. Operators shall be able to easily define these Reporting Actions using the Navigation Tree and Graphic Pane through the web browser GUI. Reporting Actions shall be as follows:
 - a. Print: Alarm information shall be printed to the BAS server's PC or a networked printer.
 - b. Email: Email shall be sent via any POP3-compatible e-mail server (most Internet Service Providers use POP3). Email messages may be copied to several email accounts. Note: Email reporting action shall also be used to support alphanumeric paging services, where email servers support pagers.
 - c. File Write: The ASCII File write reporting action shall enable the operator to

- append operator defined alarm information to any alarm through a text file. The alarm information that is written to the file shall be completely definable by the operator. The operator may enter text or attach other data point information (such as AHU discharge temperature and fan condition upon a high room temperature alarm).
- d. Write Property: The write property reporting action updates a property value in a hardware module.
 - e. SNMP: The Simple Network Management Protocol (SNMP) reporting action sends an SNMP trap to a network in response to receiving an alarm.
 - f. Run External Program: The Run External Program reporting action launches specified program in response to an event.
- H. Trends: As system is engineered, all points shall be enabled to trend. Trends shall both be displayed and user configurable through the Web Browser GUI. Trends shall comprise analog, digital or calculated points simultaneously. A trend log's properties shall be editable using the Navigation Tree and Graphic Pane.
1. Viewing Trends: The operator shall have the ability to view trends by using the Navigation Tree and selecting a Trends button in the Graphic Pane. The system shall allow y- and x-axis maximum ranges to be specified and shall be able to simultaneously graphically display multiple trends per graph.
 2. Local Trends: Trend data shall be collected locally by Multi-Equipment/Single Equipment general-purpose controllers, and periodically uploaded to the BAS server if historical trending is enabled for the object. Trend data, including run time hours and start time date shall be retained in non-volatile module memory. Systems that rely on a gateway/router to run trends are NOT acceptable.
 3. Resolution. Sample intervals shall be as small as one second. Each trended point will have the ability to be trended at a different trend interval. When multiple points are selected for displays that have different trend intervals, the system will automatically scale the axis.
 4. Dynamic Update. Trends shall be able to dynamically update at operator-defined intervals.
 5. Zoom/Pan. It shall be possible to zoom-in on a particular section of a trend for more detailed examination and 'pan through' historical data by simply scrolling the mouse.
 6. Numeric Value Display. It shall be possible to pick any sample on a trend and have the numerical value displayed.
 7. Copy/Paste. The operator shall have the ability to pan through a historical trend and copy the data viewed to the clipboard using standard keystrokes (i.e. CTRL+C, CTRL+V).
- I. Security Access: Systems that Security access from the web browser GUI to BAS server shall require a Login Name and Strong Password. Access to different areas of the BAS system shall be defined in terms of Role-Based Access Control privileges as specified:
1. Roles: Roles shall reflect the actual roles of different types of operators. Each role shall comprise a set of 'easily understood English language' privileges. Roles shall be defined in terms of View, Edit and Function Privileges.
 - a. View Privileges shall comprise: Navigation, Network, and Configuration Trees, Operators, Roles and Privileges, Alarm/Event Template and Reporting Action.
 - b. Edit Privileges shall comprise: Set point, Tuning and Logic, Manual Override, and Point Assignment Parameters.
 - c. Function Privileges shall comprise: Alarm/Event Acknowledgement, Control Module Memory Download, Upload, Schedules, Schedule Groups, Manual

Commands, Print and Alarm/Event Maintenance.

2. Geographic Assignment of Roles: Roles shall be geographically assigned using a similar expandable/collapsible navigation tree. For example, it shall be possible to assign two HVAC Technicians with similar competencies (and the same operator defined HVAC Role) to different areas of the system.

2.9 GRAPHICAL PROGRAMMING

- A. The system software shall include a Graphic Programming Language (GPL) for all DDC control algorithms resident in all control modules. Any system that does not use a drag and drop method of graphical icon programming shall not be accepted. All systems shall use a GPL method used to create a sequence of operations by assembling graphic microblocks that represent each of the commands or functions necessary to complete a control sequence. Microblocks represent common logical control devices used in conventional control systems, such as relays, switches, high signal selectors etc., in addition to the more complex DDC and energy management strategies such as PID loops and optimum start. Each microblock shall be interactive and contain the programming necessary to execute the function of the device it represents.
- B. Graphic programming shall be performed while on screen and using a mouse; each microblock shall be selected from a microblock library and assembled with other microblocks necessary to complete the specified sequence. Microblocks are then interconnected on screen using graphic "wires," each forming a logical connection. Once assembled, each logical grouping of microblocks and their interconnecting wires then forms a graphic function block which may be used to control any piece of equipment with a similar point configuration and sequence of operation.
- C. Graphic Sequence: The clarity of the graphic sequence shall be such that the operator has the ability to verify that system programming meets the specifications, without having to learn or interpret a manufacturer's unique programming language. The graphic programming shall be self-documenting and provide the operator with an understandable and exact representation of each sequence of operation.
- D. GPL Capabilities: The following is a minimum definition of the capabilities of the Graphic Programming software:
 1. Function Block (FB): Shall be a collection of points, microblocks and wires which have been connected together for the specific purpose of controlling a piece of HVAC equipment or a single mechanical system.
 2. Logical I/O: Input/Output points shall interface with the control modules in order to read various signals and/or values or to transmit signal or values to controlled devices.
 3. Microblocks: Shall be software devices that are represented graphically and may be connected together to perform a specified sequence. A library of microblocks shall be submitted with the control contractors bid.
 4. Wires: Shall be Graphical elements used to form logical connections between microblocks and between logical I/O.
 5. Reference Labels: Labels shall be similar to wires in that they are used to form logical connections between two points. Labels shall form a connection by reference instead of a visual connection, i.e. two points labeled 'A' on a drawing are logically connected even though there is no wire between them.
 6. Parameter: A parameter shall be a value that may be tied to the input of a microblock.
 7. Properties: Dialog boxes shall appear after a microblock has been inserted which has

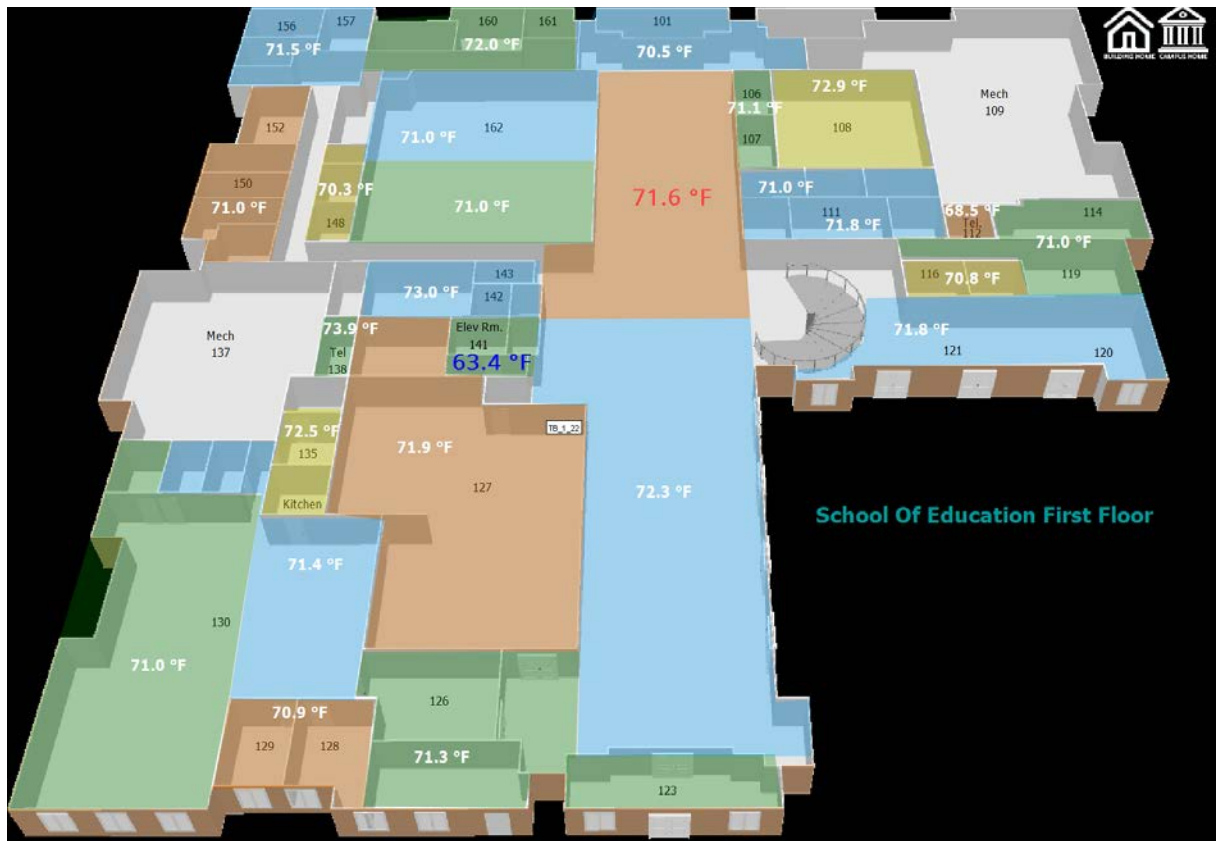
editable parameters associated with it. Default parameter dialog boxes shall contain various editable and non-editable fields and shall contain 'push buttons' for the purpose of selecting default parameter settings.

8. Icon: An icon shall be graphic representation of a software program. Each graphic microblock has an icon associated with it that graphically describes its function.
9. Menu-bar Icon: Shall be an icon that is displayed on the menu bar on the GPL screen, which represents its associated graphic microblock.
10. Live Graphical Programs: The Graphic Programming software shall support a 'live' mode, where all input/output data, calculated data and set points shall be displayed in a 'live' real-time mode.

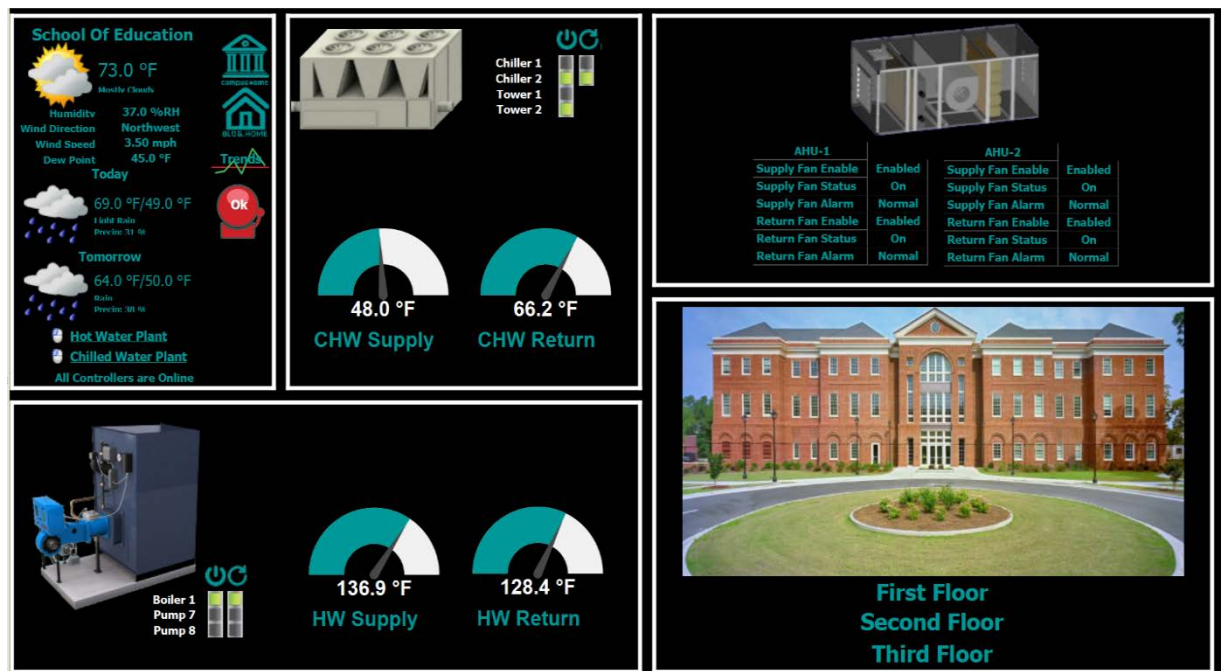
2.10 WEB BROWSER GRAPHICAL USER INTERFACE

- A. Color Graphics: The Web Browser GUI shall make extensive use of color in the graphic pane to communicate information related to set points and comfort. Animated. gifs or .jpg, vector scalable, active set point graphic controls shall be used to enhance usability. Graphics tools used to create Web Browser graphics shall be non-proprietary and conform to the following basic criteria:

1. Display Size: The GUI workstation software shall graphically display in a minimum of 1024 by 768 pixels 24-bit True Color.
2. General Graphic: General area maps shall show locations of controlled buildings in relation to local landmarks.
3. Color Floor Plans: Floor plan graphics shall be multi-colored to differentiate between the different zones and areas. Colors selected are based on a neutral palette as to not show a large variance in bright colors but more of a neutral, slightly different tones. Provide a visual display of temperature relative to their respective set points via the use of a color changing font and size that displays the zone temperature. The displayed temperature shall change to a red blinking, size 20 font for high space temperature and blue blinking, size 20 font for low space temperature. The colors and font size shall be updated as a zone's actual comfort condition changes from a normal range to a high or low out of range measurement.



4. General Graphic: A general first page for the building shall be of a standard summary format showing vital information and links to the building's operation and status. This PX page is named "overview" and is the first page to go to when accessing the building from the N4 Campus homepage.



2.11 LONWORKS NETWORK MANAGEMENT

- A. Systems requiring the use of third-party LonWorks network management tools shall not be accepted.
- B. Network management shall include the following services: device identification, device installation, device configuration, device diagnostics, device maintenance and network variable binding.
- C. The Network configuration tool shall also provide diagnostics to identify devices on the network, to reset devices and to view health and status counters within devices.
- D. These tools shall provide the ability to "learn" an existing LonWorks network, regardless of what network management tool(s) were used to install the existing network, so that existing LonWorks devices and newly added devices are part of a single network management database.
- E. The network management database shall be resident in the Site Network Controller (SNC), ensuring that anyone with proper authorization has access to the network management database at all times. Systems employing network management databases that are not resident, at all times and within the control system shall not be accepted.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 GENERAL

- A. Install system and materials in accordance with manufacturer's instructions, and as detailed on the project drawing set.
- B. Line and low voltage electrical connections to control equipment shown specified or shown on the control diagrams shall be furnished and installed by the Control System Contractor in accordance with these specifications.
- C. Equipment furnished by the Mechanical Contractor that is normally wired before installation shall be furnished completely wired. Control wiring normally performed in the field will be furnished and installed by the Control System Contractor.
- D. All control devices mounted on the face of control panels shall be clearly identified as to

function and system served with permanently engraved phenolic labels.

3.4 WIRING

- A. All electrical control wiring to the control panels shall be the responsibility of the Control System Contractor.
- B. All wiring shall be in accordance with the Project Electrical Specifications (Division 16), the National Electrical Code and any applicable local codes. All control wiring shall be installed in raceways.
- C. Excess wire shall not be looped or coiled in the controller cabinet.
- D. Incorporate electrical noise suppression techniques in relay control circuits.
- E. There shall be no drilling on the controller cabinet after the controls are mounted inside.
- F. Careful stripping of wire while inside the cabinet is required to ensure that no wire strand fragments land on circuit boards.
- G. Use manufacturer-specified wire for all network connections.
- H. Use approved optical isolation and lightning protection when penetrating building envelope.
- I. Read installation instructions carefully. Any unavoidable deviations shall be approved by owner's rep prior to installation.

3.5 SEQUENCE OF OPERATION

- A. The Contractor shall examine the Sequence of Operation in the contract documents and advise the Engineer of any anticipated problems in programming the sequence and submit specific recommendations for modifying the sequence. The Contractor shall participate in discussions with the Owner and Engineer to develop the final Sequence of Operation. It shall be the contractor's responsibility to program the sequence and make any necessary changes for proper and optimal system performance. The Contractor shall use controllers that are capable of providing the full final sequence of operation for each particular application. Any installed controllers that are demonstrated not to have that full capability shall be replaced by the Contractor with the appropriate controllers.
- B. A meeting shall be scheduled prior to installation and programming of the DDC system between the controls subcontractor, engineer, and owner to refine control strategies and determine zoning and scheduling.

3.6 ACCEPTANCE TESTING

- A. Upon completion of the installation, the Control System Contractor shall load all system software and start-up the system. The Control System Contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to ensure that the system is functioning in full accordance with these specifications.
- B. The Control System Contractor shall perform tests to verify proper performance of components, routines and points. Repeat tests until proper performance results. This testing shall include a point-

by-point log to validate 100% of the input and output points of the DDC system operation.

- C. System Acceptance: Satisfactory completion is when the Control System Contractor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

3.7 OPERATOR TRAINING

- A. During system commissioning and at such time acceptable performance of the Control System hardware and software has been established, the Control System Contractor shall provide on-site operator instruction to the owner's operating personnel. Operator instruction shall be done during normal working hours and shall be performed by a competent representative familiar with the system hardware, software and accessories.
- B. The Control System Contractor shall provide 8 total hours of comprehensive on-site training in multiple sessions for system orientation, product maintenance and troubleshooting, programming and engineering. These training sessions are to be spread out during the 1st year warranty period. The first training session starting after final commissioning and the last session is to be in the last month of 1-year warranty period.

3.8 WARRANTY PERIOD SERVICES

- A. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance.
- B. Within this period, upon notice by the Owner, any defects in the BMS due to faulty materials, methods of installation or workmanship shall be promptly repaired or replaced by the Control System Contractor at no expense to the Owner.
- C. Maintenance of Computer Software Programs: The Control System Contractor shall maintain all software during the standard first year warranty period. In addition, all factory or sub-vendor upgrades to software during the first-year warranty period shall be added to the systems, when they become available, at no additional cost. In addition to first year standard warranty, software provided by Control System Contractor shall come with a 1 Year Software Maintenance license. All SNC and BAS Servers are included in this coverage.
- D. Maintenance of Control Hardware: The Control System Contractor shall inspect, repair, replace, adjust, and calibrate, as required, the controllers, control devices and associated peripheral units during the warranty period. The Control System Contractor shall then furnish a report describing the status of the equipment, problem areas (if any) noticed during service work, and description of the corrective actions taken. The report shall clearly certify that all hardware is functioning correctly.
- E. Service Period: Calls for service by the Owner shall be honored within 24 hours and are not to be considered as part of routine maintenance.
- F. Service Documentation: A copy of the service report associated with each owner-initiated service call shall be provided to the owner.

3.9 WARRANTY ACCESS

- A. The Owner shall grant to the Control System Contractor reasonable access to the BMS during the warranty period. Remote access to the BMS (for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period) will be allowed.

3.10 OPERATION & MAINTENANCE MANUALS

- A. See Division 1 for requirements. O&M manuals shall include the following elements, as a minimum:
 - 1. As-built control drawings for all equipment.
 - 2. As-built Network Communications Diagram.
 - 3. General description and specifications for all components.
 - 4. Completed Performance Verification sheets.
 - 5. Completed Controller Checkout/Calibration Sheets.

3.11 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 230900

SECTION 232300 - REFRIGERANT PIPING AND SPECIALTIES

PART 1: GENERAL

1.1 RELATED DOCUMENTS AND RELATED WORK SPECIFIED ELSEWHERE:

A. Related Documents

1. Drawings, Standard General Conditions of the Construction Contract, including Supplementary General Conditions, Division 01 Specification sections and other Division 23 specification sections, Division 22, and Division 26 specifications apply to work of this section.

1.2 QUALITY ASSURANCE:

A. Codes and Standards:

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

1.3 SUBMITTALS:

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

PART 2: PRODUCT

2.1 PIPE AND FITTINGS:

- A. General: provide pipes and pipe fittings complying with Section 230550, in accordance with the following listing:
 1. Size 1" and Larger: Copper tube: Type K, soft annealed temper fittings; cast copper-alloy fittings for flared copper tubes; flared joints.
 2. Size 3/4" and Smaller: Copper tube; Type ACR soft annealed temper fittings; cast copper-alloy fittings for flared copper tubes; flared joints.
 3. Soldered Joints: Solder joints using silver-lead solder, ASTM B32, Grade 96 TS.

2.2 SPECIAL REFRIGERANT VALVES:

- A. General: Special valves required for refrigerant piping include the following types:

1. Globe and Check Valves:
2. Globe Shutoff Valves: Forged brass, packed, back seating, winged seal cap, 300 deg.F temperature rating, 500 psi working pressure.
3. Check Valves: Forged brass, accessible internal parts, soft synthetic seat, fully guided brass piston and stainless steel spring, 250 deg.F temperature rating, 500 psi working pressure.
4. Solenoid Valves:

5. 2-Way Solenoid Valves: Forged brass, designed to conform to ARI 760, normally closed, teflon valve seat, NEMA 1 solenoid enclosure, 24 volt, 60 Hz., UL-listed, 1/2" conduit adapter, 250 deg.F temperature rating, 400 psi working pressure.
6. Manual Operator: Provide manual operator to open valve.

2.3 MISCELLANEOUS SPECIALTIES:

- A. Refrigerant Strainers: Brass shell and end connections, brazed joints, model screen, 100 mesh, UL-listed, 350 psi working pressure.
- B. Moisture-Liquid Indicator: Forged brass, single port, removable cap, polished optical glass, solder connections, UL-listed, 200 deg.F temperature rating, 500 psi working pressure.
- C. Refrigerant Filter - Driers: Corrosion-resistant steel shell, steel flange ring and spring, wrought copper fittings, ductile iron cover plate with steel cap screws, replaceable filter-drier core, 500 psi working pressure.
- D. Evaporator Pressure Regulators: provide corrosion-resistant, spring loaded, stainless steel springs, pressure operated, evaporator pressure regulator, in size and working pressure indicated, with copper connections.
- E. Refrigerant Discharge Line Mufflers: Provide discharge line mufflers as recommended by equipment for use in service indicated, UL-listed.

2.4 PIPE ESCUTCHEONS:

- A. General: Provide pipe escutcheons as specified herein with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls or ceilings; and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime paint finish for unoccupied areas.
- B. Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons, solid or split hinged.
- C. Pipe Escutcheons for Dry Areas: Provide stamped steel escutcheons, solid or split hinged, 22 gauge minimum.

2.5 DIELECTRIC UNIONS:

- A. Provide standard products recommended by manufacturer for use in service indicated, which effectively isolate ferrous from non-ferrous piping (electrical conductance), prevent galvanic action, and stop corrosion.

PART 3: EXECUTION

3.1 INSTALLATION OF REFRIGERANT PIPING:

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

- B. Clean refrigerant piping by swabbing with dry lineless (linen) cloth, followed by refrigerant oil-soaked swab. Remove excess oil by swabbing with cloth solvent in high flash point petroleum solvent, squeezed dry.
- C. Bleed dry nitrogen through refrigerant piping during brazing operations.
- D. Provide sleeves for refrigerant piping routed under and through building floors and walls.

3.2 INSTALLATION OF PIPING SPECIALTIES:

- A. Pipe Escutcheons: Install pipe escutcheons on each pipe penetration through floors, walls, partitions, and ceilings where penetration is exposed to view and on exterior of building. Secure escutcheon to pipe or insulation so escutcheon covers penetration hole and is flush with adjoining surfaces.
- B. Dielectric Unions: Install at each piping joint between ferrous and non-ferrous piping. Comply with manufacturer's installation instructions.

3.3 FIELD QUALITY CONTROL:

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

3.4 DEHYDRATION AND CHARGING SYSTEM:

- A. Refrigerant charging shall be conducted under the supervision of an EPA certified technician. This technician shall have certification for the size and type of equipment being installed, per Section 608 of the EPA Clean Air Act.
- B. Install core in filter dryer after leak test but before evacuation
- C. Evacuate refrigerant system with vacuum pump; per manufacturer's recommendation.
- D. During evacuation, apply heat to pockets, elbows, and low spots in piping.
- E. Maintain vacuum on system for minimum of 5 hours after closing valve between vacuum pump and system.
- F. Break vacuum with refrigerant gas, allow pressure to build up 2 psi.
- G. Complete charging of system, using new filter dryer core in charging line. Provide full operating charge.

END OF SECTION 232300

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SECTION 233100 - DUCTWORK AND DAMPERS

PART 1: GENERAL

1.1 RELATED DOCUMENTS AND RELATED WORK SPECIFIED ELSEWHERE:

A. Related Documents

1. Drawings, Standard General Conditions of the Construction Contract, including Supplementary General Conditions, Division-01 Specification sections and other Division 23 specification sections, and Division 26 specifications apply to work of this section.

1.2 QUALITY ASSURANCE:

A. Codes and Standards:

1. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" and NFPA 90B "Standard for the Installation of Warm Air Heating and Air Conditioning Systems".
2. SMACNA HVAC Duct Construction Standards – Metal and Flexible - 2005
3. SMACNA Duct Leakage Test Procedures – 1985

- B. Noise and vibration control are of high importance and should be given priority during the fabrication and installation of the ductwork.

1.3 SHOP DRAWINGS:

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

1. Duct construction materials and joining systems
2. Duct sealants
3. Spiral ductwork and fittings
4. Flexible ductwork
5. Turning vanes
6. Flexible duct connections
7. Backdraft dampers
8. Duct test holes
9. Volume Control Dampers
10. Access doors
11. Fire dampers, including installation instructions

PART 2: PRODUCTS

2.1 DUCTWORK MATERIALS:

- A. Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ASTM A 527, lock forming quality; with G 90 zinc coating in accordance with ASTM A 525.
- B. Stainless Steel Sheet: Where indicated, provide stainless steel complying with ASTM A 167; Type 302, 304, or 316; with No. 4 finish where exposed to view in occupied spaces, No. 1 finish elsewhere. Protect finished surfaces with mill-applied adhesive protective paper, maintained through fabrication and installation.
- C. Aluminum Sheet: Where indicated, provide aluminum sheet complying with ASTM B 209, Alloy 3003, Temper H14.

2.2 FABRICATION:

- A. Type of duct to use for various applications:
 - 1. All exposed round supply ducts shall be double wall insulated spiral ductwork. The inside wall shall be perforated where noted on the drawings and solid otherwise. Provide with paint-grip finish in all locations exposed to view.
 - 2. Round supply ducts above ceilings shall be single wall with duct wrap unless noted otherwise.
 - 3. Rectangular supply or return ducts exposed to view shall be double wall insulated with paint-grip finish. Liner shall be solid unless within 20' of a fan, in which case it shall be perforated, unless otherwise noted.
 - 4. The duct dimensions shown indicate the inside clear dimensions for single or double wall ducts. Sheet metal sizes are to be adjusted to allow for duct liner where it is required. See duct liner installation detail on M-501.
 - 5. Rectangular ducts not exposed to view can be single wall and insulated where required by specifications or noted on the drawings.
 - 6. "Exposed to view" shall mean any space outside of a mechanical room that does not have a continuous ceiling.
- B. General:
 - 1. All low velocity sheet metal ductwork shall be constructed in accordance with recommendations of Low Pressure Duct Construction Standard, of Sheet Metal and Air Conditioning Contractors National Association, Inc., Third Edition, 2005, AIA File No. 30-D-4, hereafter abbreviated SMACNA-I and latest recommendations of the ASHRAE Handbook "HVAC Systems and Equipment." Duct systems shall be complete including all duct fittings, turning vanes, hangers, and supports shown on drawings and in SMACNA-I. Reference to plate numbers and figure numbers apply to this Duct Manual.
- C. Shop fabricated ductwork in maximum 8-ft lengths, unless otherwise indicated. Preassemble work in shop to greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to extent necessary for shipping and handling. Match-mark sections for reassembly and coordinated installation.
- D. Shop fabricate ductwork of gages and reinforcement complying with SMACNA "HVAC Duct Construction Standards" (Third Edition, 2005).
- E. Cross-break all flat panels between bracing except where rigid insulation is applied.

- F. Elbows shall be standard radius or square with air foil double vanes, round duct elbows shall be of five-piece construction.
- G. Transitions shall be made with maximum angle of 15 degrees with straight duct for diverging flow, 20 degrees for converging flow.
- H. Fabricate Ductwork with duct liner in each section of duct where indicated. Laminate liner to internal surfaces of duct in accordance with instructions by manufacturers of lining adhesive and fasten with mechanical fasteners. Note that duct sizes on the drawing are "net" and must be increased to allow for duct liner unless duct wrap type insulation is allowed in accordance with Section 230700.
- I. In the rectangular duct construction, tie rods for return air, supply air, outside air, and exhaust air will not be allowed.

2.3 FACTORY-FABRICATED SPIRAL DUCTWORK:

- A. Spiral duct shall be constructed as single wall or double wall as indicated in 2.02.a above.
- B. Material: The outer layer of double wall duct shall be galvanized steel, with gauge thicknesses per SMACNA recommendations. Exterior finish of exposed spiral ductwork shall be paintable, mill phosphated, galvanized steel.
- C. The inner liner of double wall duct shall be constructed of perforated metal within 20' of the air handling units, solid metal beyond that distance.
- D. Insulation between the inner and outer layers of double wall ductwork shall be 1" thick fiberglass with a thermal conductance of 0.27 BTU/hr/sf/deg F.
- E. Gage: Manufacturer's standard gage for the size and pressure required.
- F. Elbows: One-piece construction for 90E and 45E elbows 14" and smaller. Provide multiple gore construction for larger diameters with standing seam circumferential joint. Provide turning vanes in all 90E elbows.
- G. Divided Flow Fittings: 90E Tees, constructed with saddle tap spot welded and bonded to duct fitting body.
- H. Manufacturer: United McGill UNI-RIB for single wall, and UNI-RIB k27 for double wall, or equal by Hamlin, Lindab, Monroe Metal Mfg. Co., R.V. Money, Inc., Semco, or Eastern Sheet Metal.

2.4 FLEXIBLE DUCTWORK

- A. Type B - Round - Low Pressure
 - 1. Factory insulated with vapor barrier and factory attached clamps. Do not exceed 5-foot length. Not to exceed manufacturer recommendations for minimum bend radius. Flexible duct good for 1-1/2-inch W.G. internal S.P. and shall meet the Class I requirements of NFPA 90A.
 - 2. Flame spread rating of 25 and smoke developed rating of 50 or under.
 - 3. Each end shall be banded (draw type) for connection to duct fitting and mixing boxes.
 - 4. Insulating value shall be R5.2.

5. Make: Genflex SLR-25, Owens-Corning, Jenflex, Wiremold.

2.5 TURNING VANES:

- A. Vanes shall be manufactured from minimum 26-gauge electro-galvanized steel and sides shall be manufactured from minimum 24-gauge electro-galvanized steel with assembly slots located on design centers of 2.4 inches. Turning vanes shall be high-efficiency profile type (H.E.P.) as manufactured by AERO DYNE Sound Control Co., or approved equal by Duro Dyne, or Ductmate Industries, Inc. Submit shop drawing for approval.

2.6 FLEXIBLE DUCT CONNECTIONS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- B. Connector: Fabric crimped into metal edging strip.
 1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd.
 2. Net Fabric Width: Approximately 6 inches wide.
 3. Metal: 3-inch-wide, 24 gage galvanized steel.

2.7 BACKDRAFT DAMPERS

- A. Gravity Backdraft Dampers, Size 18 x 18 inches or Smaller, Furnished with Air Moving Equipment: Air moving equipment manufacturer's standard construction.
- B. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: 16 gage thick galvanized steel or extruded aluminum, with center pivoted blades of maximum 6-inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degrees stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.8 FIRE DAMPERS

- A. The fire dampers shall be fabricated of galvanized steel meeting ASTM-A-525-65. The damper frame shall be of such design and length as to function as the mounting sleeve, thus eliminating the need for a separate sleeve. The damper frame thickness sleeve shall not be less than as recommended in Schedule 1 of SMACNA Fire Damper and Heat Stop Guide, 2nd Ed., 1981.
- B. Unless otherwise noted, all fire dampers shall be UL 555 dynamic rating labeled for 1-1/2 hr. rating in 1 and 2 hour rated walls, and 3 hours in 4 hour rated walls. (refer to drawings).
- C. Fire dampers are required for each fire separation whether or not specifically shown on drawings. See architectural drawings and specifications for fire barriers. Fire dampers shall have 165° F fusible link.
- D. Where fire dampers are installed at a wall mounted grille, provide the style of fire damper that is UL tested for this application.
- E. All square or rectangular fire dampers shall be similar to Ruskin DIBD2, Phillips, National Controlled Air, Inc., or approved equal.

- F. Installation of fire dampers shall comply with their UL approved test. Installation instructions shall be included in the shop drawing submittal and shall be available on site at inspections.

2.9 DUCT TEST PORTS

- A. Permanent Test Ports: Factory fabricated, airtight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

PART 3: EXECUTION

3.1 INSTALLATION OF METAL DUCTWORK:

A. General:

“Exposed” shall mean any duct outside of a mechanical room that is not above a continuous ceiling.

1. Assemble and install ductwork to achieve airtight (5% leakage for systems rated 3" and under; 1% for systems rated over 3") and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth. Rigid metal ducts shall be installed with support systems in accordance with SMACNA HVAC duct construction standards. Horizontal ducts shall have a support within two feet of each elbow and within four feet of each branch intersection. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling.
2. Tape all return and supply duct joints with UL listed tape. Make shall be HARDCAST Foil-Grip 1403-181BFX, Shurtape Mastic SF-685, or Avery Dennison, except where Ductmate System is used.
3. Provide extra bracing and support for the first 30' of supply ducts from air handling units to enhance the control of noise.

B. Duct Joints

1. Transverse duct joints in rectangular ducts subject to less than 2" pressure shall be made as recommended in SMACNA-I.
2. Transverse duct joints in rectangular ducts subject to 2" or higher pressure shall be made with the Ductmate System or an approved equal. The Ductmate System components shall be of standard catalog manufacture as supplied by Ductmate Industries, Inc., of Pittsburgh, PA or Stockton, CA., Automated Ductwork Mfg. Co., McGill Airflow Corp.
3. The installation of the Ductmate System shall be in accordance with the manufacturer's printed instruction and installation manual. Ductmate joints are equivalent of SMACNA Angle Reinforced Standing Seam (T-16).
4. The Ductmate angle shall be securely fastened to the duct walls using spotwelding, self-drilling screws or rivets. Fasteners spacing shall be as recommended in the manufacturer's installation manual for the applicable pressure class.
5. A continuous strip of closed cell gasket tape, size 1/4-inch x 3/4 inch shall be installed between the mating flanges of the companion angles at each transverse joint and joint shall be made up using 3/8-inch diameter x 1 inch long plated bolts and nuts. Drive-on or snap-on cleats shall be used at spacing as recommended in the manufacturer's installation manual.

C. Round Duct

1. Ductwork shall be installed according to manufacturer's recommendations.

D. Flexible Duct

1. Install flexible ducts in accordance with Section III of SMACNA's HVAC Duct Construction Standards."
2. Flexible ducts shall be one size larger than the neck of the diffuser (U.O.N) and shall not exceed 8 feet in length, except where noted otherwise. They shall only be used at supply diffusers, not return or exhaust grilles.

E. Volume Control Dampers: Provide where specified above, where indicated on drawing and in all branches or at all supply, return air, exhaust or transfer openings required to balance system whether or not specifically shown on drawings.

1. Dampers shall be opposed blade, locking quadrant type, manual balancing clamps.
2. Blades: 22-gauge minimum galvanized sheet steel for rectangular 20 gauges for round.
3. Frames: 22-gauge minimum galvanized sheet steel for rectangular, 20 gauges for round
4. Bearings, synthetic.
5. Control shaft/hand quadrant. 3/8" square axle shaft, extending beyond frame with factory supplied locking hand quadrant for field mounting.
6. Provide 2" hand quadrant standoff bracket for dampers installed on duct wrapped with external insulation.
7. Accessibility: All dampers shall be adjustable after building is completed. Where dampers are hidden behind furred spaces, damper rods shall be adjustable from flush mounted boxes similar to the Young concealed damper regulator.
8. Make: Ruskin MD25 for rectangular and MDRS25 for round, or equivalent by Arrow United Industries, NCA or Vent Products Co., Inc. Shop built dampers will also be acceptable if constructed per SMACNA with quality of materials and features indicated above.

F. Automatic control dampers: Control dampers that are not integral to the equipment shall be furnished by the controls sub-contractor and installed by the mechanical contractor. Damper motors will be furnished by the controls sub-contractor and installed by the mechanical contractor. Refer to Specification Section 230900 – Building Management System. Control and power wiring will be provided under Division 23 of these specifications by mechanical contractor. Provide transition or blank off baffles where required to suit damper size.

G. Access Doors: Required as shown on plans and to provide access for all fire dampers, smoke detectors, coils, damper motors, dampers, bearings, etc. Sizes shall be approximately 24 inches' square wherever possible except in apparatus casing. Construction shall be double wall "sandwich style", insulated where adjoining duct or casing is insulated, in accordance with SMACNA-I construction details. Pressure rating shall be in accordance with the duct where it is installed. Provide 24 x 24 inch where possible, or largest possible size where 24 x 24 inch will not fit. Provide zero leakage access doors on supply ductwork construction of 2" pressure or higher. Zero leakage doors shall be Ductmate style "The Sandwich Door D or DR", or approved equal by C.L. Ward, or C&S Air Products.

H. Flexible Duct Connections: Install at all fans, ventilating units and ducts crossing building expansion joints and where condensation may occur.

- I. Smoke detectors and fire alarm system modules shall be furnished and wired by the fire alarm system installer.
- J. Drain Pans: Provide drain pan under each cooling coil of size as shown on drawing. Drain pan shall be made of 316 stainless steel mill finish. Provide all welded watertight joints. Drain pans shall drain towards the closest drain.
- K. Trim Collars: Wherever duct passes exposed to view through walls, the opening shall be framed with 1-inch x 1-inch x 1/8-inch angles on both sides of partitions with corners mitered, welded and ground smooth.
- L. Turning Vanes: Shall be installed in all square elbows.

3.2 ADJUSTING AND CLEANING:

- A. Clean ductwork internally, unit by unit as it is installed, of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.
- B. Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed. Similarly, provide temporary closure of ends of all prefabricated ductwork in storage.

END OF SECTION 233100

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SECTION 233423 - HVAC POWER VENTILATORS

PART 1: GENERAL

1.1 RELATED DOCUMENTS AND RELATED WORK SPECIFIED ELSEWHERE:

A. Related Documents

1. Drawings, Standard General Conditions of the Construction Contract, including Supplementary General Conditions, Division-01 Specification sections, other Division 23 specification sections, and Division 26 specifications apply to work of this section.

1.2 QUALITY ASSURANCE:

- A. AMCA Compliance: Provide power ventilators which have been tested and rated in accordance with AMCA standards, and bear AMCA Certified Ratings Seal.
- B. U.L. or CSA Approval: All power ventilators shall be U.L. Listed or C.S.A. approved.

1.3 SUBMITTALS:

- A. Manufacturer's Data: Submit manufacturer's technical data for power and gravity ventilators, including specifications, capacity ratings, dimensions, weights, materials, accessories furnished, and installation instructions.

1.4 WARRANTY

- A. Provide extended parts and labor warranty for five years from final acceptance of the building.

PART 2: PRODUCTS

2.1 GENERAL:

- A. Furnish and install all fans in accordance with capacities indicated below complete with motors and drive assemblies, belt guards, motor control equipment, disconnect switches, dampers and all accessories noted.
- B. Each fan shall bear a permanently affixed manufacturer's engraved metal nameplate containing the model number and individual serial number.
- C. Provide units with optional stainless steel fasteners.

2.2 POWER VENTILATORS:

- A. Centrifugal Sidewall or Rooftop Exhaust Fans: Provide centrifugal sidewall or rooftop type power ventilators of type, size, and capacity as scheduled, and as specified herein.

1. Type: Centrifugal fan, direct or belt driven as scheduled. Provide heavy gauge aluminum weatherproof housing. Provide wall sleeve, of length to suit wall thickness or roof curb, flashing, etc. for rooftop installation.
 2. Motors: Provide permanently lubricated, heavy duty ball bearing type motors to match the fan load and pre-wired to the specific voltage and phase for direct driven fans; capacitor start, induction run type motor for belt driven fans. High efficiency, inverter duty motors shall be provided for fans that are to have variable speed drives. Provide EC motors with mounted potentiometer dial where called for in the equipment schedule. Mount motors on vibration isolators, out of the airstream.
 3. Electrical: Provide factory wired non-fusible type disconnect switch at motor in fan housing. Provide thermal overload protection in fan motor. Provide conduit chase within unit for electrical connection. Provide solid state speed controller where scheduled.
 4. Wheel: Aluminum, non-overloading, backward inclined centrifugal wheel, statically and dynamically balanced in accordance to AMCA Standard 204-05. The wheel cone and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency.
 5. Bird Screens: Provide removable bird screens, 1/2" mesh, 16 ga aluminum or brass wire.
 6. Dampers: Provide gravity actuated louvered damper in roof curb or on sidewall intake where called for in the equipment schedule.
 7. Latches: Provide quick release latches to allow easy removal of the motor compartment cover without tools.
 8. Fans shall be Loren Cook, Greenheck, Penn Barry, Carnes, Twin City Fan or approved equal.
- B. Inline Exhaust Fans with Square Housings: Provide centrifugal inline type power ventilators of type, size, and capacity as scheduled, and as specified herein.
1. Duct mounted relief or exhaust fans shall be of the centrifugal belt driven in-line type. The fan housing shall be of the square design constructed of heavy gauge galvanized steel and shall include square duct mounting collars.
 2. Fan construction shall include two removable access panels located perpendicular to the motor mounting panel. The access panels must be of sufficient size to permit easy access to all interior components.
 3. The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced.
 4. Motors shall be heavy duty ball bearing type, carefully matched to the fan load and furnished at the specified voltage, phase and enclosure. Motors and drives shall be mounted out of the airstream. Motors shall be readily accessible for maintenance.
 5. Precision ground and polished fan shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L50) life in excess of 200,000 hours at maximum cataloged operating speed.
 6. Drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.
 7. Motor pulleys shall be adjustable for final system balancing. A NEMA 1 disconnect switch shall be provided as standard on 1/4 and 1/3 horsepower models. Refer to fan schedule for requirements on larger horsepower models. Factory wiring shall be provided from motor to the handy box.
 8. Dampers: Provide gravity actuated louvered backdraft damper where called for in the equipment schedule.

9. Fans shall be Loren Cook, Greenheck, Penn Barry, Carnes, Twin City Fan or approved equal.

PART 3: EXECUTION

3.1 INSTALLATION OF POWER VENTILATORS:

- A. Coordinate ventilator work with work of roofing, walls, and ceilings, as necessary for proper interfacing.

3.2 FIELD QUALITY CONTROL:

- A. Testing: After installation of ventilators has been completed, test each ventilator to demonstrate proper operation of units at performance requirements specified.

END OF SECTION 233423

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SECTION 233715 - AIR OUTLETS AND INLETS

PART 1: GENERAL

1.1 RELATED DOCUMENTS AND RELATED WORK SPECIFIED ELSEWHERE:

A. Related Documents

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

1.2 DESCRIPTION OF WORK:

- A. Extent of air outlets and inlets work is indicated by drawings and schedules, and by requirements of this section.
- B. Types of air outlets and inlets required for project include the following:
 1. Grilles & Registers – Louvered
 2. Exhaust, Return, and Transfer Grilles - Perforated
 3. Square Ceiling Diffusers
 4. Linear Slot Diffusers
 5. Spiral Duct Diffusers
 6. Fixed Louvers
- C. Codes and Standards:
- D. ARI Compliance: Test and rate air outlets and inlets in accordance with ARI 650 "Standard for Air Outlets and Inlets".
- E. ASHRAE Compliance: Test and rate air outlets and inlets in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".
- F. The grilles shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.
- G. NFPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

1.3 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data for air outlets and inlets including the following:
- B. Schedule of air outlets and inlets indicating drawing designation, room location, number furnished, model number, size, and accessories furnished.
- C. Data sheet for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, and mounting details.

- D. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses, throw and drop, noise criteria ratings, and minimum one-year warranty. Indicate selections on data.
 - E. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of air outlet and inlet, indicating materials and methods of assembly of components.
 - F. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals.
- 1.4 PRODUCT DELIVERY, STORAGE AND HANDLING:
- A. Deliver air outlets and inlets wrapped in factory-fabricated fiberboard type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.

PART 2: PRODUCTS

2.1 GRILLES & REGISTERS - LOUVERED

- A. General: Aluminum and steel supply grilles and registers shall be for the sizes and mounting types as shown on the plans and outlet schedule. The deflection blades shall be available parallel to the long or short dimension of the grille or register. All supply grilles shall be constructed with a 1-1/4" wide heavy aluminum border. Outer borders shall be assembled and interlocked at the four corners and mechanically staked to form a rigid frame. Screw holes shall be countersunk for a neat appearance. Grilles adjacent to fire dampers in walls or ceiling radiation dampers in ceilings shall be steel.
- B. Blades shall be constructed of heavy-duty metal and shall be designed to meet published performance data. Hollow blades are not acceptable. Blades must be solid.
 - 1. Metalaire Series 4000 or approved equal: Blades shall be spaced 2/3" or 3/4" apart. Blades shall extend completely through the side frame on each side to ensure stability throughout the complete cfm operating range of the grille. Blades shall be individually adjustable without loosening or rattling and shall be securely held in place with tension wire.
 - 2. Metalaire HDRH or approved equal: Units shall be designed to withstand moderate physical abuse. Border shall be 1-5/8" wide. Aerodynamically shaped curved blades shall be spaced on 1-1/3" centers. Deflection blades shall be fixed in place with metal screws.
- C. Finish: The grille finish shall be B12 White Powder Coat except where noted otherwise on the drawings. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM D117 Corrosive Environments Salt Spray Test without creepage, blistering, or deterioration of film. The paint must pass a 250-hour ASTM D-870 Water Immersion Test. The paint must also pass the ASTM D-2794 Reverse Impact Cracking Test with a 50-inch pound force applied.
- D. Condensation Prevention: All supply diffuser backpans shall be factory insulated with 3/4" dual density insulation with foil facing which meets the requirements of NFPA 90A and UL181. All seams and joints shall be sealed with coated cloth tape.

- E. The manufacturer shall provide published performance data for the grille.
- F. Available Manufacturers: Subject to compliance with requirements, manufacturers offering Grilles and Registers which may be incorporated in the work include; but are not limited to, the following:
 - 3. Price Industries, Inc.
 - 4. Titus Products Inc.
 - 5. Carnes Company
 - 6. Metalaire
 - 7. Nailor Industries, Inc.
 - 8. Krueger
 - 9. Tuttle & Bailey

2.2 EXHAUST, RETURN, AND TRANSFER GRILLES - PERFORATED

- A. General: Perforated exhaust and return grilles shall be of the sizes and mounting types as shown on the plans and outlet schedule. Grilles shall be aluminum with 51% free area perforated face and an aluminum border and backpan. Perforated holes shall be 3/16" diameter on 1/4" staggered centers. Units shall be designed for use in ducted return or exhaust applications.
- B. Outer border of units shall be extruded aluminum construction. The perforated face shall be removable allowing access to the interior of the grille. Face shall be secured in place with tension spring clips. Units shall be designed to integrate into the specified ceiling system.
- C. Finish: The diffuser finish shall be standard white except where noted otherwise on the drawings. Paint process shall be anodic electro-deposition using an anodic acrylic paint. Units shall undergo pre-treatment including a pressurized spray stage using an alkaline cleaner and a de-ionized water rinse.
- D. The manufacturer shall provide published performance data for the diffuser.
- E. Available Manufacturers: Subject to compliance with requirements, manufacturers offering Grilles and Registers which may be incorporated in the work include; but are not limited to, the following:
 - 1. Metalaire Model 7000R or approved equivalent by
 - 2. Price Industries, Inc.
 - 3. Titus Products Inc.
 - 4. Carnes Company
 - 5. Nailor Industries, Inc.
 - 6. Krueger
 - 7. Tuttle & Bailey

2.3 SQUARE CEILING DIFFUSERS

- A. General: Provide square ceiling diffusers, with fixed air pattern, 2 cones, aluminum or steel construction in sizes and mounting types designated by the plans and air distribution schedule.
- B. Diffusers shall consist of a precision formed back cone of one-piece seamless construction that incorporates a round inlet collar of sufficient length for connecting rigid or flexible duct. An inner cone assembly shall consist of 2 cones which drop below the ceiling plane to assure optimal VAV air diffusion performance. The inner cone assembly shall be completely removable from the diffuser

face to allow for full access to any dampers or other ductwork components located near the diffuser neck.

- C. Finish shall be B12 white powder coat except where noted otherwise on the drawings. Paint finish shall pass 500 hours of salt spray exposure with no measurable creep in accordance with ASTM D1654 and 1000 hours with no rusting or blistering as per ASTM D610 and ASTM D714.
- D. Condensation Prevention: All supply diffuser backpans shall be factory insulated with molded heavy-duty foil/scrim vapor barrier with an R-value of six, which meets the requirements of NFPA 90A and UL181. All seams and joints shall be sealed with coated cloth tape.
- E. The manufacturer shall provide published performance data for the diffuser.
- F. Available Manufacturers: Subject to compliance with requirements, manufacturers offering Square Ceiling Diffusers which may be incorporated in the work include; but are not limited to, the following:
 - 1. Price Industries, Inc.
 - 2. Titus Products Inc.
 - 3. Carnes Company
 - 4. Metalaire
 - 5. Nailor Industries, Inc.
 - 6. Krueger
 - 7. Tuttle & Bailey

2.4 LINEAR SLOT DIFFUSERS

- A. Supply Diffuser: Furnish and install supply diffusers of the sizes, configurations and mounting types indicated on the plans and air terminal schedule. Diffusers shall have the scheduled number of discharge slots, with the scheduled width of slots (1/2", 3/4", or 1" wide) with aerodynamically curved "ice-tong" shaped pattern controllers for 180 degree air pattern control and airflow dampering if required. The diffuser border shall be heavy extruded aluminum construction with extruded aluminum spacers and mitered end flanges, open ends, flush end caps or angle end caps. Continuous length units shall be provided with factory assembled corner modules to suit drawings and on-site conditions. Joiner strips shall be provided to align continuous slot assemblies.
- B. Accessory Plenums: Linear slot diffuser shall be provided with plenum assembly of the sizes, configurations and mounting types indicated on the plans and air terminal schedule. Plenums shall be constructed of zinc coated steel. Plenum assemblies shall be of a side inlet configuration with sizes to fit 1 - 4 slots. Interior of plenums shall be insulated with fiber free foam. This insulation shall have a maximum permanent flame spread rating of 25 or less and a smoke developed rating of 50 or less, as tested by ASTM E 84 (NFPA 255).
- C. Return Diffuser: Furnish and install return outlet of the sizes, configurations and mounting types indicated on the plans and air terminal schedule. Return units shall have scheduled number of intake slots, with the scheduled width of slots (1/2", 3/4", or 1" wide) and will match in appearance the model of linear supply diffusers. The border shall be heavy extruded aluminum construction with extruded aluminum spacers and mitered end flanges, open ends, flush end caps or angle end caps. Continuous length units shall be provided with factory assembled corner modules to suit drawings and on-site conditions. Joiner strips shall be provided to align continuous slot assemblies.

- D. Diffuser face and air pattern controllers shall be black. Finish on diffuser borders shall be B12 White Powder Coat unless noted otherwise. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100 hour ASTM D117 Corrosive Environments Salt Spray Test without creepage, blistering, or deterioration of film. The paint must pass a 250 hour ASTM D-870 Water Immersion Test. The paint must also pass the ASTM D-2794 Reverse Impact Cracking Test with a 50 inch pound force applied.
- E. The manufacturer shall provide published performance data for the grille.
- F. Available Manufacturers: Subject to compliance with requirements, manufacturers offering Grilles and Registers which may be incorporated in the work include; but are not limited to, the following:
 - 1. Price Industries, Inc.
 - 2. Titus Products Inc.
 - 3. Carnes Company
 - 4. Metalaire
 - 5. Nailor Industries, Inc.
 - 6. Krueger
 - 7. Tuttle & Bailey

2.5 SPIRAL DUCT DIFFUSERS

- A. General: Provide spiral duct diffusers, specifically designed for mounting on a round or spiral duct, aluminum construction in sizes designated by the plans and air distribution schedule.
- B. Diffusers shall be double deflection with adjustable front and rear blades. Supply units shall include an air extractor mounted on the back of the grille. The extractor shall be face operated using an extractor adjustment rod, or a screwdriver depending the manufacturer. The grille shall conform tightly to the duct radius and include a foam gasket around the sides and end caps of the unit. The blades shall be aerodynamically shaped and individually adjustable, with retainers to hold them in position after adjustment.
- C. Diffusers shall be painted using an anodic electro-deposition process and an anodic acrylic paint, or using a powdered coat baked anodic acrylic paint process. Color shall be per the schedule on the drawings.
- D. The manufacturer shall provide published performance data for the diffuser.
- E. Available Manufacturers: Subject to compliance with requirements, manufacturers offering Spiral Duct Diffusers which may be incorporated in the work include; but are not limited to, the following:
 - 1. Price Industries, Inc.
 - 2. Titus Products Inc.
 - 3. Carnes Company
 - 4. Metalaire
 - 5. Nailor Industries, Inc.
 - 6. Krueger
 - 7. Tuttle & Bailey

2.6 FIXED LOUVERS

- A. General: Except as otherwise indicated, provide manufacturer's standard fixed louvers where shown; of size, shape, capacity and type indicated, and as required for complete installation. Louver shall protect against wind driven rain. It shall be a drainable type with a drain gutter in each blade and downspouts in frame jambs and mullions.
- B. Performance: Provide fixed louvers that comply with requirements for minimum free area, and maximum pressure drop for each type as listed in manufacturer's current data, complying with louver schedule.
- C. Substrate Compatibility: Provide fixed louvers with frame and sill styles that are compatible with adjacent substrate, and that are specifically manufactured to fit into construction openings with accurate fit and adequate support, for weatherproof installation. Frames to be flanged type unless noted to be channel type on the drawings. Refer to architectural drawings for detailing of types of frames required.
- D. Materials: Construct of aluminum extrusions, ASTM B 221, Alloy 6063-T52. Weld units or use stainless steel fasteners.
- E. Sills: Provide sill extensions and loose sills made of same materials as louvers, for drainage to exterior and to prevent water penetration to interior.
- F. Louver Screens: On inside face of louvers, provide 1/4" square mesh anodized aluminum wire bird screens mounted in removable extruded aluminum frames.
- G. Finish: Provide Kynar finish for all fixed louvers, color to be selected by the designer.
- H. Sealants: Refer to Section 07900 – Sealants.
- I. Available Manufacturers: Subject to compliance with requirements, manufacturers offering fixed louvers which may be incorporated in the work include; but are not limited to, the following:
 - 1. Arrow United Industries, Inc.
 - 2. Greenheck
 - 3. Louvers & Dampers, Inc.
 - 4. Ruskin Mfg. Co.
 - 5. Safe-Air Inc.
 - 6. Vent Products Co., Inc.
 - 7. United Enertech

PART 3: EXECUTION

3.1 INSTALLATION:

- A. General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to ensure that products serve intended functions.
- B. Provide all control components and accessories as necessary for complete, operational functioning of louver-dampers and associated fans.

END OF SECTION 233715

SECTION 236200 - PACKAGED HEAT PUMP ROOFTOP UNITS

PART 1: GENERAL

1.1 SYSTEM DESCRIPTION:

- A. Outdoor roof curb or slab mounted, electronically controlled heating and cooling unit utilizing scroll type compressors for cooling duty and gas or electric heat for heating duty. Units shall discharge supply air vertically or horizontally as shown on contract drawings.

1.2 QUALITY ASSURANCE:

- B. Unit shall be rated in accordance with AHRI Standard 360.
- C. Unit shall conform to ANSI Z21.47/UL1995 for construction of packaged air conditioner.
 - 1. In the event the unit is not UL approved, the manufacturer must, at his expense, provide for a field inspection by a UL representative to verify conformance to UL standards. If necessary, contractor shall perform modifications to the unit to comply with UL, as directed by the UL representative, at no additional expense to the Owner.
- D. Unit shall be designed to conform to ANSI/ASHRAE 15 and 37 (latest edition) and NEC.
- E. Roof curb (when required) shall be National Roofing Contractors Associations (NRCA) approved.
- F. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.

1.3 DELIVERY, STORAGE AND HANDLING:

- A. Unit shall be stored and handled per manufacturer's recommendations.

PART 2 PRODUCTS

2.1 EQUIPMENT:

- A. Factory-assembled, single-piece heating and cooling unit as scheduled on contract documents. Unit(s) shall consist of insulated weather-tight casing with compressor(s), air-cooled condenser coil, condenser fans, evaporator coil, return-air filters, supply motors and unit controls. Units shall be convertible for bottom or side airflow design as manufactured.
- B. Unit(s) shall be 100% factory run tested and fully charged with R-410A.
- C. Unit Cabinet:
 - 1. Constructed of galvanized steel, phosphatized, and finished with weather resistant baked enamel finish with removable access panels. Structural members shall be 18 gauge with access doors and removable panels of minimum 20 gauge.
 - 2. Units cabinet surface shall be tested 672 hours in salt spray test in compliance with ASTM B117.

3. Cabinet top cover shall be one piece construction or where seams exist, it shall be double-hemmed and gasket-sealed.
4. Water- and air-tight panels with handles shall provide access to filters, heating section, supply air fan section, evaporator coil section, and unit control section.
5. Insulation: Provide 1/2 inch thick fiberglass insulation with foil face on all exterior panels in contact with the return and conditioned air stream. All edges must be captured so that there is no insulation exposed in the air stream.
6. Unit shall have a factory-installed condensate drain connection and a reversible, sloped PVC condensate drain pan to prevent standing water from accumulating.
7. The base of the unit shall have 3 sides for forklift provisions. The base of the units shall have rigging/lifting holes for crane maneuvering.
8. Filters shall mount integral within the unit and shall be accessible through access panels. One-inch thick glass fiber disposable media filters shall be provided with the provisions within the unit for 2 inch thick filters to be field- provided and installed.

D. Fans:

1. Indoor Evaporator Fans:
 - a. Double-width/double-inlet, centrifugal, belt driven, forward-curved centrifugal type with single outlet discharge.
 - b. Fan shaft shall be solid steel, ground, polished and coated with rust-preventive oil.
 - c. Provide self-aligning, grease lubricated, ball or sleeve bearings with permanent lubrication fittings.
 - d. Statically and dynamically balanced.
 - e. Provide 6 tons and above with belt driven, supply fans with adjustable motor sheaves.
2. Condenser Fans:
 - a. Direct-driven propeller type only, with corrosion-resistant blades riveted to corrosion-resistant steel supports.
 - b. Discharge air vertically upward and protected by wire safety guards.
 - c. Statically and dynamically balanced.
 - d. Fan motor shall be permanently lubricated and have internal thermal overload protection.

E. Compressors:

1. Scroll compressor with direct drive operating at 3600 rpm with integral centrifugal oil pump. Provide suction gas cooled motor with winding temperature limits and compressor overloads.
2. Provide each unit with 1 or 2 refrigerant circuits per equipment schedule, factory-supplied completely piped with liquid line filter-drier, suction and liquid line pressure ports.
3. For heat pump units, provide reversing valve, discharge muffler, flow control check valve, and electronic adaptive demand defrost control on all units.

F. Coils:

1. Evaporator Coil:

- a. Provide configured aluminum fin surface mechanically bonded to copper tubing coil.
- b. Provide an independent expansion device for each refrigeration circuit.
- c. Coils shall be leak tested at 200 psig and pressure tested at 450 psig.

2. Condenser Coil:

- a. Provide configured aluminum fin surface mechanically bonded to copper tubing coil.
- b. Air-cooled condenser coils shall be leak tested at 200 psig and pressure tested at 450 psig.
- c. All coils shall be same manufacturer as unit.

G. Heating Section:

1. Auxiliary Electric Heat:

- a. Electric resistance heaters shall be factory-installed, heavy duty nickel chromium heating elements internally wired, and include operating and safety controls. Heater shall have pilot duty or automatic reset line voltage limit controls and any circuit carrying more than 48 amps shall have fuse protection in compliance with N.E.C. Heater shall be UL and CSA listed and approved and provide single point power connection.

H. Controls and Safeties:

1. Controls:

- a. Provide factory-wired roof top units with 24-volt electro-mechanical control circuit with control transformers, contactors pressure lugs or terminal block for power wiring. Contractor to provide combination starter-disconnect. Units shall have single point power connection as standard. Field wiring of zone controls to be NEC Class II.

2. Safeties: Unit components shall be equipped with the following protections:

a. Compressors:

- i. Overtemperature (shuts down individual compressor).
- ii. Overcurrent (shuts down individual compressor).

b. Crankcase heaters.

- i. High-pressure switch (shuts down individual compressor, automatic reset type).
- ii. Loss-of-charge switch (shuts down individual compressor, automatic reset type).

- c. Compressor shall be prevented from restarting for a minimum of 5 minutes after shutdown. Compressor shall run a minimum of 10 seconds after starting.
- d. Freeze protection thermostat (FPT) shall shut down unit operation based on coil temperature.
- e. Defrost control board and defrost sensor.

3. Electric Heat:

- a. Automatic reset high-temperature limit switches.

- b. Heat limiters (fusible links).
- c. Overcurrent protection short-circuit fuses.
- d. Branch circuit protection.
- e. Sequencer and fan relay.

I. Operating Characteristics:

- 1. Unit shall be capable of starting and running at 115 F ambient outdoor temperature per maximum load criteria of ARI Standard 360.
- 2. Unit shall be capable of mechanical cooling operation down to 0° F ambient outdoor temperature.
- 3. Provides multi-stage mechanical cooling capability.
- 4. Unit provided with fan time delay to prevent cold starts.

J. Electrical Requirements: All unit power wiring shall enter unit cabinet at a single location.

K. Integrated Economizer:

- 1. Provide the optional economizer accessory. The assembly shall include fully modulating 0-100 percent motor and dampers, minimum position setting, preset linkage, wiring harness and plug, and spring return actuator.
- 2. Dampers shall be low leakage type, not to exceed 20 cfm per sq ft leakage at 1 in. wg pressure differential when fully closed.
- 3. Motor shall have a spring return feature which shuts dampers upon a power interruption or unit shutdown.
- 4. Motor shall be controlled by 4 to 20 mA input.

L. Special Features:

- 1. Condenser Coil Hail Guard:

Hood with welded wire grille complete with support retainers and fasteners shall be provided for protection of condensing coil(s).

2.2 MANUFACTURER: Trane, Carrier, York or Daikin-McQuay.

PART 3 - EXECUTION

3.1 INSTALLATION OF ROOF TOP UNITS:

- A. General: Install roof top units where indicated, in accordance with equipment manufacturer's published installation instructions, and with recognized industry practices, to ensure that units comply with requirements and serve intended purposes. Refer to sequence of operation on the drawings.

3.2 FIELD QUALITY CONTROL:

- A. Testing: Upon completion of installation of roof top units, start-up and operate equipment to demonstrate capability and compliance with requirements. Field correct malfunctioning units, then retest to demonstrate compliance.

- B. Balancing: Balance roof top units to provide design performance. Change fan speed as needed.
- C. Training: Provide 2 hours training specific to the equipment at the job site by a factory trained service technician. Training should include levels of expertise that range from operator to full factory trained technician.

3.3 SPARE PARTS

- A. Provide one set of filters.
- B. Furnish a complete set of fan motor drive belts.

END OF SECTION 236200

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SECTION 238147 - SPLIT SYSTEM AIR COOLED HEAT PUMPS

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND RELATED WORK SPECIFIED ELSEWHERE:

A. Related Documents

1. Drawings, Standard General Conditions of the Construction Contract, including Supplementary General Conditions, Division-01 Specification sections and other Division 23 specification sections, Division 22, and Division 26 specifications apply to work of this section.

1.2 SUBMITTALS:

- A. Manufacturer's Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, weights (shipping, installed, and operating), dimensions, required clearances, and methods of assembly of components, furnished specialties and accessories; and installation and start-up instructions.
- B. Wiring Diagrams: Submit ladder-type wiring diagrams for power and control wiring required for final installation of condensing units and controls. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

1.3 QUALITY ASSURANCE:

A. Codes and Standards:

1. Capacity ratings for heat pump/condensing units shall be in accordance with ARI Standard 360, "Standard for Commercial and Industrial Unitary Air-Conditioning Equipment" for units of 135 MBH capacity or greater; ARI Standard 210 "Standard for Unitary Air-Conditioning Equipment" for units of capacity less than 135 MBH.
2. Refrigeration system of heat pump/condensing units shall be constructed in accordance with ASHRAE standard ASHRAE 15 "Safety Code for Mechanical Refrigeration".

PART 2 PRODUCTS

2.1 AIR-COOLED HEAT PUMP/CONDENSING UNITS:

- A. General: Factory assembled and tested high efficiency, inverter driven, split system air-cooled heat pump/condensing units, consisting of casing, compressors, condenser coils, condenser fans motors, and unit controls. Capacities and electrical characteristics as scheduled. Acceptable refrigerants shall be R-410A or R-134A.
- B. Manufacturers: Provide systems that meet the specification requirements by Carrier, Daikin, EMI, Mitsubishi, Sanyo, Johnson Controls, Trane, or York.
- C. Indoor Split Unit: Designed for indoor installation and complete with protection for components and controls. Provide the following with the unit.

1. Freezestat to prevent coil freezeup.
 2. Built in power failure automatic restart.
 3. Wall mounted, 24 volts, electronic programmable thermostat capable of 5/1/1 programming and night/weekend set-back function.
 4. Automatic Heating and Cooling Changeover.
 5. Single zone.
 6. Low ambient heating capability in ductless units, 75% of heating capacity at 5°F.
 7. Auxiliary electric heat in ducted units.
- D. Outdoor Heat Pump Section: Hermetic scroll-type compressor, designed for air-cooled condensing, complete with crankcase sight glass, crankcase heater, thermal expansion valve, and backseating service access valves on suction and discharge ports. Capacity shall be controlled by cycling or modulating compressor speed. Additional features shall include:
1. Crankcase heater in well within crankcase;
 2. Capacity steps as scheduled or recommended by manufacturer.
- E. Controls: Operating and safety controls shall include high and low pressure cutouts, oil pressure cutout, compressor winding thermostat cutout, 3-leg compressor overload protection, and condenser fan motors with thermal and overload cutouts. Provide magnetic contactors for compressor and condenser fan motors. Provide modulating condenser fan for head pressure control at low ambient conditions. Provide automatic nonrecycling pump down, timing device to prevent excessive compressor cycling, and time delay relays for dual compressor units.
- F. Condensing Section: Condenser coil shall be aluminum micro-channel type, and systems shall utilize a separate compressor for each indoor air handling unit. Units shall include liquid accumulator and subcooling circuit, and backseating liquid line service access valve. Condenser coils shall be factory tested.

PART 3 EXECUTION

3.1 INSTALLATION:

- A. General: Install air-cooled heat pump/condensing units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

3.2 FIELD QUALITY CONTROL:

- A. Charge systems with refrigerant and oil, and test for leaks. Repair leaks and replace lost refrigerant and oil.

3.3 DEMONSTRATION:

- A. Start-up air-cooled heat pump/condensing units, in accordance with manufacturer's start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

- B. Train Owner's personnel on start-up and shutdown procedures, troubleshooting procedures, servicing, and preventive maintenance schedule and procedures. Review with the Owner's personnel, the data contained in the Operating and Maintenance Manuals specified in Division One.

END OF SECTION 238148

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SECTION 238148 - DUCTLESS SPLIT SYSTEM AIR COOLED HEAT PUMPS

PART 1: GENERAL

1.1 RELATED DOCUMENTS AND RELATED WORK SPECIFIED ELSEWHERE:

A. Related Documents

1. Drawings, Standard General Conditions of the Construction Contract, including Supplementary General Conditions, Division-01 Specification sections and other Division 23 specification sections, Division 22, Division 26, and Division 28 specifications apply to work of this section.

1.2 SUBMITTALS:

- A. Manufacturer's Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, weights (shipping, installed, and operating), dimensions, required clearances, and methods of assembly of components, furnished specialties and accessories; and installation and start-up instructions.
- B. Wiring Diagrams: Submit ladder-type wiring diagrams for power and control wiring required for final installation of condensing units and controls. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

1.3 QUALITY ASSURANCE:

A. Codes and Standards:

1. Capacity ratings for heat pump/condensing units shall be in accordance with ARI Standard 360, "Standard for Commercial and Industrial Unitary Air-Conditioning Equipment" for units of 135 MBH capacity or greater; ARI Standard 210 "Standard for Unitary Air-Conditioning Equipment" for units of capacity less than 135 MBH.
2. Refrigeration system of heat pump/condensing units shall be constructed in accordance with ASHRAE standard ASHRAE 15 "Safety Code for Mechanical Refrigeration".

PART 2: PRODUCTS

2.1 AIR-COOLED HEAT PUMP/CONDENSING UNITS:

- A. General: Factory assembled and tested high efficiency, inverter driven, ductless split system air-cooled heat pump/condensing units, consisting of casing, compressors, condenser coils, condenser fans motors, and unit controls. Capacities and electrical characteristics as scheduled. Acceptable refrigerants shall be R-410A or R-134A.
- B. Manufacturers: Provide systems that meet the specification requirements by Daikin, EMI, Mitsubishi, or Sanyo.
- C. Indoor Ductless Split Unit: Designed for indoor installation and complete with protection for components and controls. Provide the following with the unit.

1. Freezestat to prevent coil freezeup.
 2. Built in power failure automatic restart.
 3. Wall mounted, 24-volt, electronic programmable thermostat capable of 5/1/1 programming and night/weekend set-back function.
 4. Automatic Heating and Cooling Changeover.
 5. Single zone.
 6. Low ambient heating capability, 75% of heating capacity at 5°F.
- D. Outdoor Heat Pump Section: Hermetic scroll-type compressor, designed for air-cooled condensing, complete with crankcase sight glass, crankcase heater, thermal expansion valve, and backseating service access valves on suction and discharge ports. Capacity shall be controlled by cycling or modulating compressor speed. Additional features shall include:
1. Crankcase heater in well within crankcase;
 2. Capacity steps as scheduled or recommended by manufacturer.
 3. Painted steel wall mounting brackets.
- E. Controls: Operating and safety controls shall include high and low pressure cutouts, oil pressure cutout, compressor winding thermostat cutout, 3-leg compressor overload protection, and condenser fan motors with thermal and overload cutouts. Provide magnetic contactors for compressor and condenser fan motors. Provide modulating condenser fan for head pressure control at low ambient conditions. Provide automatic nonrecycling pumpdown, timing device to prevent excessive compressor cycling, and time delay relays for dual compressor units.
- F. Condensing Section: Condenser coil shall be seamless copper tubing mechanically bonded to heavy duty, configured aluminum fins, systems shall utilize a separate compressor for each indoor air handling unit. Units shall include liquid accumulator and subcooling circuit, and backseating liquid line service access valve. Condenser coils shall be factory tested.

PART 3: EXECUTION

3.1 INSTALLATION:

- A. General: Install air-cooled heat pump/condensing units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

3.2 FIELD QUALITY CONTROL:

- A. Charge systems with refrigerant and oil, and test for leaks. Repair leaks and replace lost refrigerant and oil.

3.3 DEMONSTRATION:

- A. Start-up air-cooled heat pump/condensing units, in accordance with manufacturer's start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

- B. Train Owner's personnel on start-up and shutdown procedures, troubleshooting procedures, servicing, and preventive maintenance schedule and procedures. Review with the Owner's personnel, the data contained in the Operating and Maintenance Manuals specified in Division One.

END OF SECTION 238148

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SECTION 238239 - ELECTRIC UNIT HEATERS

PART 1: GENERAL

1.1 RELATED DOCUMENTS AND RELATED WORK SPECIFIED ELSEWHERE:

A. Related Documents

1. Drawings, Standard General Conditions of the Construction Contract, including Supplementary General Conditions, Division 01 Specification sections, other Division 23 specification sections, and Division 26 specifications apply to work of this section.

1.2 QUALITY ASSURANCE

A. Codes and Standards:

1. UL listed.
2. ETL listed.
3. Conforms to OSHA and NEC when installed in accordance with manufacturer's instructions.

B. Submittals:

1. Manufacturer's Data: Submit manufacturer's specifications for terminal units showing dimensions, capacities, ratings, performance characteristics, gages and finishes of materials, and installation instructions.

PART 2: PRODUCTS

2.1 ELECTRIC UNIT HEATERS

- A. Casing. Casing shall be fabricated of die-formed, heavy-gauge steel and finished in high gloss, baked enamel. Supply air shall be drawn through a stamped louver periphery evenly across the heating element and discharged through an outward drawn Venturi. Adjustable discharge louvers shall be provided to control the direction of airflow. A large, hinged access door shall extend the width of the heater and be locked in position by quarter-turn fasteners. Heater and supply wiring diagram shall be permanently attached to the inside of the access door.
- B. Elements. Elements shall be high mass, all steel tubular finned type, copper brazed, centrally located and installed in fixed element banks.
- C. Motors. Motors shall be totally enclosed, all angle industrial rated. All units 3.3 through 20 kW will utilize sealed bearings to assure permanent lubrication.
- D. Fan Blades. Fan blades shall be of the axial flow-type designed for quiet efficient operation. Fan speed shall not exceed not exceed 1,600 rpm (26.7 R.P.S.)
- E. Wiring. Heaters shall be designed for a single circuit, with elements, motor and control circuits subdivided with factory-wired fuses to conform to the National Electric Code and Underwriter's

Laboratory, Inc., Standard 1278. All three-phase heaters shall have balanced phases. Unit shall be provided with a disconnect switch.

- F. Thermal Overload Protection. All heaters shall be equipped with automatic reset thermal overloads which shut down the element and motor if safe operating temperatures are exceeded.
- G. Fusing. Element, motor and transformer primary fusing shall be factory installed and wired where required by NEC. Branch circuit fusing shall be installed where required (48 amps and up).
- H. Units shall be controlled by unit built in thermostat.
- I. Make: Trane, Markel, Q Mark, Chromalox.

PART 3: EXECUTION

3.1 INSTALLATION OF ELECTRIC HEATERS:

- A. GENERAL: Install units as indicated, and in accordance with manufacturer's installation instructions.
- B. Locate units as indicated. Coordinate with other trades.
- C. Protect units with protective covers during balance of construction.

END OF SECTION 238239

SECTION 260000 - GENERAL REQUIREMENTS

PART 1 – GENERAL

- 1.1 This section is intended to supplement or modify the conditions and requirements defined in the General or Project Requirements given in the General Requirements of this specification. The General Requirements and this Section shall apply to all electrical work as described in Electrical Specification Sections 26 00 00 through 26 09 99.
- 1.2 WORK COVERED BY CONTRACT DOCUMENTS
- A. All work, materials, etc., shall be furnished and installed, whether or not specifically shown on the drawings and/or called for in the specifications, which may be necessary to comply with all of the requirements, due to the exigencies of the work, to complete the work and the contract in a satisfactory and approved manner.
 - B. The work to be done under this contract shall consist of furnishing all equipment, labor, materials required for the items listed in the proposal, and/or as shown on the contract drawings, together with all devices, connectors, splices and appurtenances, required for a safe, clean, complete and ready for service, reliable, substantial and rugged working installation, to the satisfaction of the Engineer and to execute the intent of this contract and these specifications.
 - C. The Contractor shall be responsible for determining the proper connection points for all power, control, and signal wiring installed under this contract, regardless of whether the connection points are in equipment furnished under this contract, existing equipment, or equipment furnished by others. The Contractor shall include in his bid prices any field surveys, wire tracing or other work required to ascertain the proper connection points for all wiring.
 - D. It is the intent of these specifications that the Contractor shall furnish equipment and material which is suitable for the purpose and for installation in the location as specified, and which is adequate and satisfactory for the service intended.
 - E. It is also the intent of the specification that the equipment, materials and accessories, as furnished, shall be complete in all respect and ready to operate.
 - F. The specifications cover the general design, construction arrangement, and certain particular features, but do not purport to cover all details entering into the design of the equipment and accessories.
 - G. Minor revisions in construction details will be made to accommodate equipment proposed and approved on the drawings thereof, submitted by the Contractor. Major revisions shall not be made nor shall equipment be submitted for approval which cannot be installed in structures of the approximate dimensions and character specified herein.
 - H. Further, it is also the intent of these specifications to provide a complete contract including items which may be omitted or not shown but which are considered normal and accepted engineering practice for this type of contract at no additional cost to the Owner.

- I. All work shall be done in a thorough and workmanlike manner and shall conform to the best modern practice in the manufacture and installation of high-grade equipment and materials. Wherever possible, all parts shall be made according to standard gauge to facilitate replacement and repair.
- J. All materials furnished under these items shall be the best of their respective kinds and shall be free from defects in design and workmanship.
- K. All materials or equipment not meeting the specified requirements shall be rejected, and shall be replaced at once by the Contractor with materials or equipment of the specified type and quality, at no cost to the Owner.
- L. All materials for which no detailed specifications are given herein shall be of the quality and character best adapted and suitable for the purpose for which they are to be used and shall be subject to the approval of the Engineer.
- M. Where any material or article or the maker or distributor thereof is specified by name, this is done for the purpose of more clearly describing the type or quality desired. Any material or article of equal quality, merit and performance, in the opinion of the Engineer, will be acceptable, if approval is given in writing.
- N. All materials furnished and work done by the Contractor shall be subject to the inspection of the Engineer. Defective materials shall be removed from the site of the work and defective work repaired or replaced as directed. Facilities for handling and inspection of materials and equipment and for access to the work in progress, shall at all times be furnished by the Contractor.
- O. Where any delay is encountered in carrying out work due to unfavorable operating conditions, the Contractor shall not be entitled to additional compensation therefore, but the time allowed equivalent to the period of actual delay.

1.3 DESCRIPTION OF WORK

- A. Work includes all labor, equipment, wiring, termination, testing and documentation to satisfy the design intend described in the contract documents for all electrical, tele/data and lighting systems in the building to the satisfaction of the Engineer.
- B. Unless specifically dimensioned, the work shown on the drawings is diagrammatic, and is intended only to show general arrangement.
- C. Include in the work, all accessories and devices necessary for the intended operation or perfection of any system, whether or not specifically shown or specified.
- D. The term "Furnish" shall mean to obtain and supply to the job site. The term "Install" shall generally mean to fix in position and connect for use. Where language indicates that one party or trade is to "install" and another is to "connect", the term "install" shall mean only to fix in position, and "connect" shall mean to make electrical connections to. The term "Provide" shall mean to furnish and install.
- E. Testing & Start-Up:

1. Start-up & test each component of all building systems covered by the contract documents.

1.4 STANDARD OF QUALITY

- A. The specifications establish the standards of quality required, either by description or by references, to brand name, name of manufacturers or manufacturer's model number. All materials shall be new unless noted otherwise.
- B. Where one or multiple products are specifically identified by name or manufacturer's model number, the cited examples are used only to denote the quality standard of the product desired and they do not restrict the contractor to a specific brand, make, manufacturer or specific name. They are used only to set forth and convey to bidders the general style, type, character and quality of product desired. The function, performance and quality of the specified item shall meet the criteria set forth. Equivalent or better products will be acceptable unless an item is specifically identified on the bid sheet as an owner-preferred alternate item in compliance with NC. G.S. 133.3.
- C. The Contractor may submit, with his bid, the names of products which are proposed as substitutions for products named in the specifications. Each proposed substitution shall be accompanied by a written sum of money to be added or deducted from his bid. The Owner reserves the sole right to accept or reject said substitutions with or without cause.
- D. When equipment and/or materials are proposed to be purchased from a manufacturer other than those specified, the Contractor shall provide complete data adequate for the Engineer's evaluation of the proposed substitution.
- E. When the equipment other than that specified is used, the Contractor shall be responsible for any extra cost of required revisions such as structural steel, concrete, electrical, piping, etc. Such additional costs shall be identified at the time such substitutions are proposed.

1.5 SUBMITTALS

- A. Engineers review of shop drawings is solely for the benefit of the Owner and in no way relieves the contractor from his obligations to furnish materials which satisfy the requirements of his contract and the design intent.
- B. Shop drawings, product data and samples shall be submitted as required by the General Conditions or Project Requirements and as supplemented by this section.
- C. When a specific specification section identifies that no submittal is required, the contractor shall provide the specified materials without submittals.
- D. Provide to the Engineer, a schedule of shop drawing submissions identifying submittal target dates.
- E. The Contractor shall review, approve and submit shop drawings, with promptness so as to cause no delay in his work or in that of others. No submissions will be accepted by the Engineer without the signed review and approval of the Contractor.

- F. The Contractor shall check and verify pertinent field measurements, and quantities of equipment and materials required.
- G. Submittals shall be identified by reference to the drawing(s), section(s) of specifications, or equipment symbols to which they relate.
- H. Shop drawings, when required, shall include:
 - 1. Verification of information given in Contract Documents such as performance, dimensions, weight, materials, construction, types, models, manufacturer, etc.
 - 2. Equipment layouts drawn to scale as may be required.
 - 3. Wiring diagrams and schematics for equipment.
 - 4. Any special construction conditions.
 - 5. Other information/data as may be requested.
- I. All submittals shall identify the specific details of the product or assembly. All optional features being provided or proposed shall be so noted or the submittal will be rejected.
- J. The Engineer will return submittals with one of the following notations stamped thereon; REVIEWED, REVIEWED AS NOTED, REVISE AND RESUBMIT, REJECTED or SUBMIT SPECIFIED ITEM AND THE FOLLOWING:
 - 1. Review is only for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Any action shown is subject to the requirements of the plans and specifications. Contractor is responsible for: dimensions which shall be confirmed and correlated at the job site; fabrication processes and techniques of construction; coordination of his work with that of all other trades; and the satisfactory performance of his work.
 - 2. The work involved may proceed when submittals are marked REVIEWED or NO EXCEPTIONS TAKEN with no further submission required.
 - 3. The work involved may proceed when submittals are marked REVIEWED AS NOTED providing corrections are made and submittals are resubmitted for record. Review does not authorize changes to Contract Sum unless stated in a separate letter or Change Order. If any notes placed on the submittals by the Engineer are believed to result in a change in the Contract Sum, the Engineer shall be notified immediately, and fabrication may not be undertaken until written authorization to proceed is issued by the Owner.
 - 4. The work involved may not proceed when submittals are marked REVISE AND RESUBMIT. Submittals must be corrected and resubmitted for review.
 - 5. Submittals marked REJECTED OR SUBMIT SPECIFIED ITEM are not in accordance with the Contract Documents and require a new submittal for review.
- K. For items being resubmitted, clearly identify changes made from the initial submittal requested by the Engineer. The Engineer will review only those changes requested and identified by the Contractor.

1.6 PROTECTION OF WORK

- A. Each Contractor is responsible for the protection of his materials, equipment, and completed work as defined in the General or Project Requirements and as supplemented herein.

- B. All openings into any part of the conduit systems, all fixtures and equipment must be securely covered or otherwise protected to prevent damage due to dropped tools or materials, work by others or intrusion of grit, dirt, water, snow, ice or other foreign matter. Remove burrs, dirt, paint spots and debris. The Contractor shall be held responsible for all damage done to unprotected work or materials.
- C. All equipment on site, whether stored or installed, shall be protected with weather tight covers.

1.7 STEEL AND CONCRETE WORK FOR ELECTRICAL EQUIPMENT

- A. Steel
 - 1. Provide all miscellaneous steel supports and anchors required for equipment and materials installed under this Specification. Manual of Construction by American Institute of Steel Construction latest edition shall be followed in design and construction except that the second sentence of paragraph 4.2.1., Section 4 of Division 5, page 5-177 will not apply. Structural steel members shall conform to ASTM A36, and shall have a shop applied coat of rust inhibiting paint.
 - 2. Welding of steel shall conform to American Welding Society, Standard Code for Arc and Gas Welding in Building Construction.
 - 3. Bolts, nuts and washers for structural steel framing and concrete embedment shall be high tensile type minimum 3/4" diameter conforming to ASTM A325.
- B. Slotted-steel channel supports shall have flange edges turned toward web, and 9/16-inch diameter slotted holes at a maximum 2 inches o.c., in webs. Channel depth: 2-1/2 inches minimum. Channel thickness: selected to suit structural loading. Fittings and Accessories: Products of the same channel manufacturer. Channel supports and fittings shall be hot dip galvanized steel.
- C. Concrete work and anchors
 - 1. Refer to Section 260050 and Division 03 for concrete work and anchors.

1.8 COUNTERFLASHING

- A. Where conduits or other items pass through any roof, wall or other exterior component, provide counter flashing as required.

1.9 EQUIPMENT BY OTHERS

- A. Section - Summary of Work, together with other technical sections in the Project Manual, describe equipment that will be furnished by the Owner or from other sources.
- B. The responsibility for setting, installation and protection of such equipment will be defined in other sections of the Project Manual.
- C. Provide services rough-in for and make final connections to this equipment as shown and specified.
- D. Provide coordination to assure clearances required for moving equipment to final location.

1.10 MOVING AND INSTALLATION OF RACEWAYS, DEVICES AND EQUIPMENT

- A. Verify that electrical equipment will pass through all restricting openings, and when equipment or sections of equipment are larger than these openings, install this equipment prior to construction of enclosing walls, floors or roofs.
- B. Use planking or cribbing as required to protect adjoining construction from damage.
- C. Provide rigging and scaffolding with expert rigging / scaffolding personnel as required for equipment installation in difficult locations. Rigging & scaffolding shall include any necessary structural investigation and temporary structural support.

1.11 CUTTING AND PATCHING

- A. Provide all openings through walls, floors and ceilings, etc. required for the installation of work defined on the drawings and specifications.
- B. Following installation and testing, restore floors, walls and ceilings with materials equal to the original construction and finish to match existing surfaces.
- C. Cutting and patching shall be performed only by tradesmen familiar with the construction involved.

1.12 IDENTIFICATION

- A. Refer to Section 26 01 95.

1.13 FINAL ACCEPTANCE

- A. The Contractor shall perform and complete work in accordance with the Contract Documents without fault or defect of any kind. In the absence of more specific directives, the work shall:
 - 1. Be completed in a first-class manner.
 - 2. Be placed in a thoroughly clean and unmarred condition.
 - 3. Be checked out in a step-by-step manner to ascertain that fastenings, controls, parts, safety devices, operating devices and other required appurtenances have been provided in accordance with the Contract Documents.
 - 4. Be free of previously condemned or rejected parts and be properly restored to an acceptable condition.
 - 5. Be adjusted for proper operation wherever adjustments or calibrations exist in the work.
 - 6. All systems shall be operated to demonstrate that the requirements of the Contract have been met and that the systems have been adjusted and will operate in accordance therewith.

1.14 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Furnish for review, three hard bound copies of complete written instructions for the operation, care and maintenance of each piece of equipment and/or system. Include recommended frequency of inspection, cleaning, oiling, greasing, and adjustment and other action as may be required in accordance with manufacturer's recommendations. Material shall include manufacturer's brochures, catalog cuts, parts lists, wiring diagrams, service organizations, etc.

1.15 PERMITS, FEES AND CERTIFICATES OF APPROVAL

- A. Contractor shall acquire all required permits and certificates. Inspection fees fixed by counties and municipalities shall not be applicable per GS143-135.1.
- B. Contractor shall provide all power, labor and instruments required for tests and cleaning of systems.
- C. Whenever tests are required, three (3) copies of the test reports shall be submitted to the Engineer.
- D. Tests may be observed by the Engineer or his representative. Notify the Engineer a minimum of three weeks in advance of test dates.

1.16 COMPLIANCE WITH CODES, STANDARDS AND REGULATIONS

- A. In the absence of specific instruction in the technical specifications, equipment and installation shall conform to the following applicable codes, standards and regulations, latest editions:
 - 1. American Society for Testing and Materials (ASTM)
 - 2. American National Standard Institute (ANSI)
 - 3. Underwriter's Laboratories, Inc. (UL)
 - 4. American Welding Society Code (AWSC)
 - 5. NFPA 70, "National Electrical Code", latest edition
 - 6. National Electrical Manufacturer's Association (NEMA).
 - 7. Occupational Safety and Health Act (OSHA).
 - 8. National Fire Protection Association (NFPA).
 - 9. National Electrical Safety Code (NESC)
 - 10. North Carolina State Building Code. (NCSBC)
 - 11. Institute of Electrical and Electronics Engineers (IEEE)
 - 12. Illuminating Engineering Society of North American (IESNA)
 - 13. State and Local Building, Electric, and Fire Codes and Regulations.

1.17 PAINTING

- A. Cabinet trims and similar prefabricated equipment shall be factory primed and finish painted with baked enamel in color selected. This equipment shall not be painted in the field unless the factory finishes have been marred or as otherwise directed. Do not paint over UL or similar labels or mechanical/electrical nameplates.
- B. Exposed conduit visible to the public shall be painted to match adjacent finish. Prime conduits for better adhesion of paint.

1.18 COORDINATION OF WORK

- A. Coordinate installation of conduit runs and equipment with other trades and conditions in the building and participate in all coordinated shop drawings. Variance from work shown on drawings will be subject to approval. Where interference occurs and electrical work is directed to be relocated, provide such relocation without additional cost.

1.19 LOCATION OF OUTLETS

- A. Examine all architectural and vendor drawings before locating outlets. Place outlets as required to harmonize with moldings, panels, cabinets, mirrors, etc. Do not scale dimensions on electrical drawings but use measurements from architectural drawings.
- B. If an outlet is installed in such a location as to be out of proper relation to beams, walls, or other details of the building, relocate the outlet as directed. A relocation allowance of 10 ft. shall be understood by the Contractor with no extra cost to the Owner.
- C. Unless otherwise indicated, outlet boxes in walls shall be located with center line at the following elevation above the Finish floor line. Verify with Contractor for General Construction, all heights prior to actual layout of work.

1. Switch Outlets	3 feet - 10 inches
2. Bracket Outlets (Stairs)	7 feet - 0 inches
3. Bracket Outlets (Other)	6 feet - 6 inches
4. Telephone Outlets (Wall)	4 feet - 1 inch
5. Telephone and Data Outlets (Other)	1 foot - 6 inches. Unless otherwise noted
6. Receptacle Outlets	1 foot - 6 inches. Unless otherwise noted.
7. Receptacle Outlets	3 feet - 0 inches in Mechanical Rooms
10. Motor Starters and Safety Switches required	4 feet - 0 inches to 6 feet - 0 inches as required
11. Panel Boards (top)	6 feet - 0 inches

1.20 ACCESS PANELS

- A. Furnish access panels where required, to concealed pull boxes, junction boxes, or similar equipment located above dry wall board ceiling or behind walls. Installation of access panels shall be by mechanics of the pertinent trade under General Construction.
- B. Access panels shall be 18" x 18" minimum, 16 gage wall or ceiling frame and a 14-gage panel door with not less than 1/8" fire proofing secured to the inside of the door. The door shall be provided with concealed hinges and cylinder lock, and prime-coated steel prepared for painting. Each door shall be capable of opening 180 degrees. Doors for wall panels shall be secured with suitable clips and counter sunk tamperproof screws.
- C. Access panels shall have "label" fire rating equal to the ceiling or wall surface.

1.21 WARRANTY

- A. The contractor and equipment manufacturers shall jointly guarantee all wiring and equipment to be free of defects in workmanship and material for a period of one year from the date of final acceptance, unless otherwise noted.

1.22 PROJECT RECORD DOCUMENTS

- A. Maintain at job site, one copy of record documents and samples as required under the General Conditions of the Contract, including Drawings, Specifications, Addenda and Bulletins, Change Orders, Shop Drawings, Product Data and Samples, Field Orders, Field Test Records and Maintenance and Operating Manuals.

- B. Provide files and racks for storage of documents. Maintain documents in a clean, dry legible condition and in good order. Do not use record documents for construction purposes. Make record documents and samples available during normal working hours for inspection.
- C. Recording:
 - 1. Label each document "Project Record" in neat large letters and provide final completion date.
 - 2. Record information concurrently with construction progress.
 - 3. Do not conceal any work until required information is recorded.
- D. Record Drawings - legibly mark to record actual construction as follows:
 - 1. A print set (blue-line or black-line) of contract drawing or shop drawing mark-ups of actual installations which vary substantially from the work as originally shown. Mark whichever drawing is most capable of showing "field" condition fully and accurately; however, where shop drawing are used for mark-up, record a cross reference at corresponding location on working drawings. Mark with red erasable pencil and, where feasible, use other colors to distinguish between variation in separate categories or work. Mark-up new information which is recognized to be of importance to Owner, but was for some reason not shown on either contract drawings or shop drawings. Give particular attention to concealed work which would be difficult to measure and record at a later date. Note related change order numbers where applicable.
- E. Record Specifications and Addenda, Bulletins, Requests for Information (RFI's) and Construction Clarification Sketches (CSK's) - legibly mark each Section to record:
 - 1. Any variations in actual work in comparison with text of specifications and modifications as issued. Give particular attention to substitutions, selection of options, and similar information work where it is concealed or cannot otherwise be readily discerned at a later date by direct observations. Note related record drawing information and product data, where applicable.
 - 2. Changes made by Field Order or by Change Order.
- F. Product Data: Maintain one copy of each product data submittal, and mark-up significant variation in actual work in comparison with submitted information.
 - 1. Include both variations in product as delivered to site, and variations from manufacturer's instruction and recommendations for installation.
 - 2. Give particular attention to concealed products and portions of the work which cannot otherwise be readily discerned at a later date by direct observations. Note related change orders and mark-up of record drawings and specifications.
- G. Record Drawings Submittal at Project Completion: Organize record drawing sheets into manageable sets, bind with durable paper cover sheets and print suitable titles, dates and other identification on cover of each set. Transfer marking required by previous paragraphs to set of reproducible transparencies. Submit complete set of transparencies to the Design Professional and two sets of blue-line prints.
- H. Product Data Submittal at Project Completion: Submit three sets of marked-up product data submittals for record purposes that include resolution of all review notes and field revisions.

- I. Record Sample Submittals: Immediately prior to date of substantial completion Design Professional (and including Owner's personnel where desired) will meet with Contractor at site and will determine which if any of submitted samples maintained by Contractor during progress of work are to be transmitted to Owner for record purposes. Comply with Design Professionals instruction for packaging, identification marking, and delivery to Owner's sample storage space.
- J. Miscellaneous Record Submittals: Refer to other sections of these specification for requirements of miscellaneous record-keeping and submittals in connection with actual performance of the work. Immediately prior to date(s) of substantial completion, complete miscellaneous records and place in good order properly identified and bound or filed, ready for continued use and reference. Submit to Architect/Engineer for Owner's records.
- K. Maintenance Manuals: Organize maintenance-and-operating manual information into three suitable sets of manageable size and bind into individual binders properly identified and indexed (thumb-tabbed). Include: emergency instructions; spare parts listing; warranties; wiring diagrams; recommended "turn-around" cycles; inspection and cleaning procedures; recommended frequency of testing, adjustment and any other maintenance requirements; shop drawings; product data; and similarly, applicable information. Bind each manual of each set-in heavy duty 2-inch, vinyl-covered ring binder, and include pocket folders for folded sheet information. Mark identification on both front and spine for each binder.

END OF SECTION 260000

SECTION 260010 - GENERAL PROVISIONS

PART 1 - GENERAL

1.1 SCOPE

- 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.

1.2 REFERENCES

- A. NCBCC: North Carolina Building Code Council.
- B. NCCSB: North Carolina State Building Code
- C. NEC: National Electrical Code (NFPA 70)

1.3 QUALITY ASSURANCE

- A. See the General and Supplementary General Conditions and Division 1.
- B. Work shall be in accordance with the 2018 edition of the North Carolina State Building Code, and the 2017 edition of the National Electrical Code (NFPA 70).
- C. The Contractor shall be responsible for notifying the State Electrical Inspectors in the Construction Administration Section of the State Construction Office to schedule required inspections as work progresses.
- D. 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.
- 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 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.
- 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 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. Items that are submitted for approval after this date will not be accepted. Substitute material and equipment will not be deemed to be approved until notification is given in a written addendum prior to the bid date.
- G. All materials and equipment shall comply with NEMA 250 standard as follows:
 - 1. Interior Dry Locations in Production Areas: Type 12.
 - a. The Sound Stage is classified as Production Area.
 - 2. Interior Dry Locations in Non-Production Areas: Type 1.
 - 3. Exterior, Wet and Damp Locations: Type 3R.

1.4 SUBMITTALS

- A. See General and Supplementary General Conditions & Division 1.
- B. Within twenty (20) 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 materials, which he proposes to use. Items requiring submittal data for approval will be noted at this time. One electronic set of submittal data shall be provided in pdf format 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 drawings and specifications as well as space limitations and other project conditions, before submittal to the Engineer for review. The submittals shall be clearly identified showing project name, manufacturer's catalog number and all necessary performance and fabrication data. All requirements, parameters, information, details and other information noted about submitted equipment in the specifications and on the drawings shall be specifically addressed in the submittal. Submittals that do not contain this information will be returned to the contractor for resubmittal. The same 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. Upon completion of the project, the Contractor shall submit to the Engineer a set of accurately marked-up plans indicating all changes encountered during the construction. These drawings shall remain on the project for its duration and shall be updated at the time changes are made. Final payment will be contingent on receipt of these "Record Drawings."
- 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.

1.5 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. Any broken, damaged or weather damaged material or equipment shall be removed from the project site and replaced at the contractor's expense before installation.
- C. The material and equipment shall remain the property of the Contractor until the project has been completed and turned over to the Owner.

1.6 WORK CONDITIONS AND COORDINATION

- A. Safety switches built in to equipment shall be furnished by the contractor furnishing the equipment. The electrical contractor shall furnish safety switches not built in to equipment. The electrical contractor shall review the plans and specifications of other trades to verify whether safety switches are furnished with equipment.

- B. All starters shall be furnished by the contractor furnishing the equipment.
- C. The electrical contractor shall provide power wiring to, a termination point consisting of a junction box, trough or gutter, starter or safety switch. The electrical contractor shall also furnish junction boxes, troughs and gutters. Final connections of the raceways and wire from those termination points to the equipment, except for food service equipment, shall be by the contractor furnishing the equipment. Final connections to food service equipment shall be by the electrical contractor.
- D. Pipe, conduit and duct 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.
- E. All work shall be coordinated with other trades. Cutting of new work, due to this contractor's negligence, and subsequent patching shall be approved by the Architect/Engineer and shall be at this contractor's expense with no extra cost to the Owner.

1.7 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.

1.8 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by third party agencies accredited by the NCBCC to label electrical and mechanical equipment as suitable for purpose specified and shown, where such listing exists.

PART 2 - PRODUCT

- 2.1 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.

PART 3 - EXECUTION

3.1 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/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.

3.2 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. The Architect/Engineer shall require written approval 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. 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 equipment.
- F. Grounding:
 - 1. All grounding shall be in accordance with the requirements of the NEC.
 - 2. The main service shall be grounded with driven rods, to building steel (where available) and to the domestic metal water main where it enters the building.
 - 3. The secondary neutral of each dry type transformer shall be bonded to the conduit system, building steel (where available), the domestic metal water line and to transformer case.
 - 4. A grounding conductor sized per the latest edition of the NEC shall be installed in all raceways containing power conductors.

3.3 PERFORMANCE

- A. The Contractor shall perform all excavation and backfill operations necessary for installation of his work.

3.4 ERECTION

- A. All support steel, angles, channels, pipes or structural steel stands and anchoring devices that may be required to rigidly support or this Contractor shall provide anchor material and equipment.

3.5 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 repaired unless damaged areas exist. The manufacturer shall touch up these areas with a material suitable for the intended service so that the finish is equal to that provided. 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 260010

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SECTION 260035 - ELECTRICAL TESTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Electrical Testing

1.2 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specifications and other Division 26 Specification Section, apply to this Section.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

- A. Equipment for electrical testing.
 - 1. For feeder insulation testing provide a 500-volt cable insulation tester.
 - 2. For ground resistance testing, provide a ground resistance tester capable of accurately reading 0 to greater than 25 ohms.
 - 3. For ground fault testing of receptacles and circuit breakers provide equipment that will accurately produce and read a ground fault of 1mA through 20mA in 1mA increments at full line voltage.
 - 4. During the final inspection, the contractor shall furnish a cable insulation tester and ground resistance meter and demonstrate to the Engineer and State Construction Office (SCO) personnel the fall-of-potential method ground resistance measurements except in urban settings with no access to bare earth, where the clamp-on in-line method shall be used. At the time of inspection demonstrate also that panel feeders comply with the requirements stated in the above paragraphs. The contractor shall also furnish a True RMS clamp-on ammeter and voltmeter to take readings as requested by the Engineer and SCO personnel.
- B. Provide any miscellaneous material such as wire or cable, extension cords, insulating tape or materials, clamps, etc., to implement all testing procedures noted in this specification.

PART 3 - EXECUTION

3.1 FEEDER INSULATION RESISTANCE TESTING

- A. Test all current carrying phase conductors and neutrals as installed, and before connections are made, for insulation resistance and accidental grounds. This shall be done with a 500-volt wire insulation tester. The testing procedures listed below shall be followed:
 - 1. Minimum readings shall be one million (1,000,000) or more ohms for #6 AWG and smaller wire and 250,000 ohms or more for #4 AWG or larger wire, between phase and

neutral conductors, and between phase and neutral conductors and the grounding conductor.

2. After all fixtures, devices and equipment are installed and all connections are completed to each panel, the contractor shall disconnect the neutral feeder conductor from the neutral bar and take a wire insulation tester 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 conductors from this neutral bar. He shall then test each one separately to the panel until the low readings are found.
3. The contractor shall correct the problems, reconnect and retest the wires until at least 250,000 ohms from the neutral bar to the grounded panel can be achieved with only the neutral feeder disconnected.
4. The contractor shall send a letter to the Engineer certifying that the above test has been done, and tabulating the cable insulation readings for each panel. This shall be done at least four (4) days prior to final inspection.

3.2 GROUND SYSTEM TESTING

- A. Upon completion of installation the electrical grounding and bonding systems, test the ground resistance with a ground resistance tester. Where tests show resistance to ground is over 25 ohms, drive additional ground rods as necessary to reduce the ground resistance to 25 ohms or less. Retest to demonstrate that the resistance is less than or equal to 25 ohms.

3.3 CIRCUIT BREAKER TESTS

- A. For services 1000 amperes and larger, perform the following tests on the service and distribution circuit breakers. A qualified factory technician at the job site shall perform testing. All readings shall be tabulated:
 1. Phase tripping tolerance. Adjust or replace circuit breakers until the settings are within 20% of UL tolerances.
 2. Trip time (per phase) in seconds.
 3. Instantaneous trip (in amperes) per phase.
 4. Insulation resistance (in Megohms) at 100 volts (phase-to-phase and line-to-line).

3.4 DOCUMENTATION

- A. All tests specified shall be completely documented indicating time of day, date, temperature and all pertinent test information.
- B. All required documentation of readings indicated above shall be submitted to the Engineer prior to, and as one prerequisite for, the final acceptance of the project.

END OF SECTION 260035

SECTION 260051 - UNDERGROUND DUCTS AND PULL BOXES

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 the following:

- 1. Ducts in direct-buried duct banks.
- 2. Ducts in concrete-encased duct banks.
- 3. Distribution cabinets and handhole accessories.
- 4. Pullboxes and Pullbox accessories.

- B. Related Sections include the following:

- 1. Division 26 Section "Grounding and Bonding" for grounding electrodes, counterpoise conductors, clamps and connectors for grounding metallic Pullbox and handhole accessories and testing of grounds.

1.3 SUBMITTALS

- A. Product Data: For the following:

- 1. Pullbox hardware.
- 2. Conduit and ducts, including elbows, bell ends, bends, fittings, and solvent cement.
- 3. Duct-bank materials, including spacers and miscellaneous components.
- 4. Warning tape.

- B. Shop Drawings: Show fabrication and installation details for underground ducts and utility structures and include the following:

- 1. For Pullboxes:
 - a. Duct sizes and locations of duct entries.
 - b. Reinforcement details.
 - c. Pullbox cover design.
 - d. AASHTO rating.

- C. Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures. Include plans and sections drawn to scale and show all bends and location of expansion fittings.

- D. Product Certificates: For concrete and steel used in underground precast Pullboxes, according to ASTM C 858.

- E. Product Test Reports: Indicate compliance of Pullboxes with ASTM C 857 and ASTM C 858, based on factory inspection.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories (Including Ducts for Communications and Telephone Service): Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with ANSI C2.
- C. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store precast concrete units at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.
- B. Lift and support precast concrete units only at designated lifting or supporting points.

1.6 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated.
 - 1. Notify Owner and Engineer at least two weeks in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Owner's written permission.
- B. Existing Rock: Removal of rock encountered during underground work and replacement with subsoil and 6" topsoil to maintain existing grading is included in this project.
- C. Restore any disturbed landscaping to original condition.

1.7 COORDINATION

- A. Coordinate layout and installation of ducts, pullboxes, and distribution cabinets with final arrangement of other utilities and site grading, as determined in the field.
- B. Coordinate elevations of ducts and duct-bank entrances into pullboxes and distribution cabinets with final profiles of conduits as determined by coordination with other utilities and underground obstructions. Revise locations and elevations from those indicated as required to suit field conditions and to ensure duct runs drain to gravel pits below pullboxes and distribution cabinets, and as approved by Engineer.
- C. Coordinate landscaping and grading with owner.
- D. Coordinate exact routing of new underground raceways with Engineer.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Underground Precast Concrete Utility Structures:

- a. Christy Concrete Products, Inc.
- b. Rotondo Precast/Old Castle.
- c. Utility Vault Co.
- d. Quazite Precast Products

2. Nonmetallic Ducts and Accessories:

- a. Southern Pipe, Inc.
- b. Carlon Electrical Products.
- c. Cantex, Inc.
- d. Certainteed Corp.; Pipe & Plastics Group.
- e. Duraline

2.2 CONDUIT

- A. Conduit and fittings used above grade are specified in Division 26 Sections "Conduit" and "Boxes".

2.3 DUCTS

- A. Rigid Nonmetallic Conduit: HDPE Schedule 40 Nema TC-7 and UL 651A listed smoothwall conduit for electrical wiring in raceway.
- B. Rigid Nonmetallic Conduit: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by the same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.
- C. Rigid Nonmetallic Conduit: NEMA TC 2, Type EPC-80-PVC, UL 651, with matching fittings by the same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B. Oversize Schedule 80 PVC conduits as required to maintain inner diameter of run.

2.4 HDPE DUCT FITTINGS

- A. Coupling for transition of HDPE duct to galvanized rigid conduit and intermediate metal conduit. Air and water tight coupling without reduction in inner diameter. Listed to UL514B standard for direct burial underground applications, HDPE conduit, and wet locations.

2.5 PRECAST PULLBOXES

- A. Precast Units: ASTM 478, with interlocking mating sections, complete with accessories, hardware, and features as indicated. Open bottom with concrete knockout panels for conduit entrance and sleeve for ground rod.
- B. Design and fabricate structure according to ASTM C 858.

- C. Minimum size: 17 inches wide, 30 inches long and 24 inches deep. Use larger size as needed for sweeps, pulling, conductor volume or as otherwise found necessary.
- D. Provide open bottom precast box on 12" deep compacted broken stone pit with coarse ~1" aggregate. Stack boxes for required depth.
- E. Structural Design Loading: ASTM C 857, Class A-16.
- F. Joint Sealant: Continuous extrusion of asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.
- G. Source Quality Control: Inspect structures according to ASTM C 1037.
- H. Unit, when buried, shall be designed to support AASHTO H10 loading.

2.6 ACCESSORIES

- A. Duct Spacers: Rigid PVC interlocking spacers, selected to provide minimum duct spacings and cover depths indicated while supporting ducts during concreting and backfilling; produced by the same manufacturer as the ducts.
- B. Pullbox Frames and Covers: Comply with AASHTO loading specified for Pullbox.
 - 1. Provide cast covers with cast-in legend: "ELECTRICAL".
 - 2. Special Covers: Recess on cover designed to accept finish material in paved areas.
- C. Grounding Materials: Comply with Division 26 Section "Grounding and Bonding."
- D. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F. Capable of withstanding temperature of 300 deg F without slump and of adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.
- E. Warning Tape: Underground-line warning tape specified in Division 16 Section "Electrical Identification."

2.7 CONSTRUCTION MATERIALS

- A. Waterproofing: Provide "Composite Sheet Waterproofing."
- B. Dampproofing: Provide "Bituminous Dampproofing."
- C. Concrete: Use 3000-psi- (20.7-MPa-) minimum, 28-day compressive strength and 3/8-inch maximum aggregate size. Concrete and reinforcement are per Section 260045.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Ducts in soft shoulder, non-traffic areas: Direct buried underground HDPE Schedule 40 Nema TC-7 and UL 651A listed smoothwall conduit for electrical cable.
- B. Pullboxes: Underground precast polymer concrete utility structures set on 12-inch-deep crushed stone coarse fraction 3/4" to 1-1/2" aggregate pit.
- C. Direct buried vertical sweeps: Direct buried underground HDPE Schedule 40 Nema TC-7 and UL 651A listed smoothwall conduit for electrical cable.
- D. Underground runs less than 10' in length NEMA TC 2, Type EPC-40-PVC or Type EPC-80-PVC, UL 651, with matching fittings by the same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B. Oversize Schedule 80 PVC conduits as required to maintain inner diameter of run.
- E. Stub-ups: IMC or RMC conduit.

3.2 EARTHWORK

- A. Excavation and Backfill: Comply with Division 31 Section "Earthwork". Do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- C. Restore all areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching.
- D. Do not disturb pavement, concrete channels, stormwater piping or any other existing structures. Refer to Division 31 "Horizontal Directional Drilling"

3.3 CONDUIT AND DUCT INSTALLATION

- A. Slope: Pitch ducts a minimum slope of 1:300 down toward Pullboxes and away from equipment. Slope ducts from a high point in runs between two Pullboxes to drain in both directions.
- B. Curves and Bends: Follow manufacturer's recommendation for minimum bending radii and field-installation. For Fiber-optic cables do not use tighter than the cable manufacturer's published minimum bending radii.
- C. Duct entrances to Pullboxes: Stub-up conduits from below and through gravel beds. Extend min. 12" above gravel bed. Horizontal entry is not permitted to avoid filling of conduit.
 - 1. Reinforcement: Reinforce duct banks where they cross disturbed earth and where indicated.
 - 2. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
 - 3. Minimum Clearances between Ducts: 3 inches between ducts and exterior envelope wall and 4 inches between power and signal ducts.
 - 4. Depth: Install top of duct bank at least 18 inches below finished grade in nontraffic areas and at least 30 inches below finished grade in vehicular traffic areas, unless otherwise indicated.

- D. Direct-Buried Ducts: Support ducts on duct spacers, spaced as recommended by manufacturer and coordinated with duct size, duct spacing, and outdoor temperature. Install as follows:
1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts.
 2. Install expansion fittings as shown on Shop Drawings.
 3. Trench Bottom: Continuous, firm, and uniform support for duct bank. Prepare trench bottoms as specified in Division 2 Section "Earthwork" for pipes less than **6 inches** in nominal diameter.
 4. Backfill: Install backfill as specified in Division 2 Section "Earthwork." After installing first tier of ducts, backfill and compact. Repeat backfilling after placing each tier. After placing last tier, hand-place backfill to **4 inches** over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, complete backfilling normally.
 5. Minimum Clearances between Ducts: **7-1/2 inches** between ducts for like services and between power and signal ducts.
 6. Depth: Install top of duct bank per the NEC and at least **18 inches** below finished grade.
- E. Warning Tape: Bury warning tape approximately **12 inches (300 mm)** above all duct banks. Align tape parallel to and within **3 inches** of the centerline of duct bank.
- F. Stub-ups: Use IMC, RMC for stub-ups to equipment. For equipment mounted on outdoor concrete bases, extend conduit a minimum of **12 inches** from edge of base. Install insulated grounding bushings on terminations. Couple steel conduits to ducts with adapters designed for this purpose and encase coupling with **3 inches** of concrete.
- G. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least **15-psig** hydrostatic pressure.
- H. Pulling Cord: Install **100-lbf**- test nylon cord in ducts, including spares.

3.4 INTERFACES WITH EXISTING MANHOLES

- A. Follow UNCW and OSHA safe entry protocol for manholes. Furnish all safety equipment including but not limited to ladders, tripods, lines, harnesses, radios and positive pressure ventilation.
- B. Protect existing installations from damage, concrete slip during ductbank pour and detritus.
- C. Pump dry manhole and maintain water level below sump. Clean bottom as needed for firm footing.
- D. Excavate to min. 6' below grade to enter manhole min. 5' below grade and as needed to maintain pitch. Refer to Dewatering Section 310913.
- E. Cut manhole wall to a flare for a positively engaged concrete plug with min. (6) 10' #5 rebar with a 6" bent J engaging the manhole wall and installed alongside ducts to take forces due to any settling of ductbank.

- F. Last 50' of ductbank and plug shall be in one monolithic pour.
- G. Ducts entering manholes shall have bell ends to facilitate cable pulls.
- H. Provide saddles and hardware to support cable loops min. 75% of the manhole's circumference or 16', whichever is longer. Loop, lay and strap cables to minimize strain.

3.5 PULLBOX INSTALLATION

- A. Elevation: Install Pullboxes with level cover. Stub collar ½" above finished grade. Shape grade around box to not exceed 1 over 3 slope.
- B. Precast Concrete Pullbox Installation: Unless otherwise indicated, comply with ASTM C 891.
 - 1. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.
 - 2. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

3.6 FIELD QUALITY CONTROL

- A. Testing: Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
- B. Duct Integrity: Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of the duct. If obstructions are indicated, remove obstructions and retest.
- C. Correct installations if possible and retest to demonstrate compliance. Remove and replace defective products and retest.

3.7 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of Pullboxes and manholes. Remove soils and other foreign material.

END OF SECTION 260051

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SECTION 260111 - CONDUIT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Metal conduit.
- B. Flexible metal conduit.
- C. Liquid tight flexible metal conduit.
- D. Electrical metallic tubing.
- E. Nonmetallic conduit.
- F. Fittings and conduit bodies.
- G. Electrical nonmetallic tubing.
- H. Surface metal raceway

1.2 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specifications and other Division 260 Specification Section, apply to this Section.

1.3 REFERENCES

- A. ANSI C80.1 Rigid Steel Conduit, Zinc Coated.
- B. ANSI C80.3 Electrical Metallic Tubing, Zinc Coated.
- C. ANSI/NEMA FB 1 Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
- D. ANSI/NFPA 70 National Electrical Code.
- E. NECA "Standard of Installation."
- F. NEMA TC 3 PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.4 DESIGN REQUIREMENTS

- A. Conduit Size: ANSI/NFPA 70.

1.5 SUBMITTALS

- A. Submit under provisions of Section 260010.

- B. Product Data: Provide for metallic conduit, flexible metal conduit, liquid tight flexible metal conduit, metallic tubing, nonmetallic conduit, nonmetallic tubing, fittings and conduit bodies.

1.6 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 260010.
- B. Accurately record actual routing of conduits larger than 1½" inch.

1.7 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by third party agencies accredited by the NCBCC to label electrical and mechanical equipment as suitable for purpose specified and shown, where such listing exists.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Accept conduit on site. Inspect for damage.
- B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- C. Protect PVC conduit from sunlight.

1.9 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Verify routing and termination locations of conduit prior to roughin.
- C. Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required completing wiring system.

PART 2 - PRODUCTS

2.1 CONDUIT REQUIREMENTS

- A. Minimum Size: ½" trade size unless otherwise noted.

2.2 METAL CONDUIT

- A. Rigid Steel Conduit: ANSI C80.1.
- B. Intermediate Metal Conduit (IMC): Rigid steel.
- C. Fittings and Conduit Bodies: ANSI/NEMA FB 1; all steel, plated, hexagonal, compression type fittings. Pot metal, setscrew or indenter type fittings will not be accepted.

- D. IMC and rigid conduit shall terminate with either a double locknut/bushing set, or in a threaded hub.

2.3 FLEXIBLE METAL CONDUIT

- A. Description: Interlocked steel or aluminum construction.
- B. Fittings: ANSI/NEMA FB 1.
- C. Sizes: ½” and larger are acceptable for motor, appliance and fixture connections provided a green grounding conductor is installed. The grounding conductor and the flexible conduit size shall meet NEC requirements.

2.4 LIQUID TIGHT FLEXIBLE METAL CONDUIT

- A. Description: Interlocked steel construction with PVC jacket with integral copper grounding conductor.
- B. Fittings: ANSI/NEMA FB 1.
- C. Sizes: ½” and larger are acceptable for motor, appliance and fixture connections provided a green grounding conductor is installed. The grounding conductor and the flexible conduit size shall meet NEC requirements.

2.5 ELECTRICAL METALLIC TUBING (EMT)

- A. Description: ANSI C80.3; galvanized tubing.
- B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; all steel, hexagonal compression, insulated throat type. Pot metal, setscrew or indenter type fittings shall not be used. Provide rain tight fittings in damp locations.
- C. Do not install in locations where EMT or fittings will be in contact with earth or underground (in or below slab on grade or in earth); any location where the tubing would be exposed to the elements; or where exposed to severe corrosive influence and/or severe physical damage.

2.6 NONMETALLIC CONDUIT

- A. Description: NEMA TC 2; Schedule 40 or 80 PVC.
- B. Fittings and Conduit Bodies: NEMA TC 3.

2.7 ELECTRICAL NONMETALLIC TUBING

- A. Description: NEMA TC 2.
- B. Fittings and conduit bodies: NEMA TC 3.

PART 3 - EXECUTION

3.1 CONDUIT USES

A. Underground Installations:

1. Outside of Foundation Wall (with the exception of branch circuit raceways): Use a type approved by the NEC as "suitable for concrete encasement", with a minimum of three (3) inches of concrete on all sides, and a minimum cover of eighteen (18) inches, except for circuits with voltages above 600 volts, which shall have a minimum cover of thirty (30) inches.

B. Branch circuits 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 3/4 inch.

C. Raceways run underground internal to building foundation walls shall be of a type and installed in a method approved by the NEC.

D. Where underground raceways are required to turn up into cabinets, equipment, etc., the elbow required and the stubup out of the slab shall be of schedule 80 PVC conduit oversized for same or greater inner diameter as the lateral run. Provide all required transition fittings. Where underground raceways are required to turn up on to poles, walls or other exposed structures subject to physical impact provide rigid steel conduit.

E. Outdoor Locations, Above Grade: Use rigid steel or intermediate metal conduit.

F. Wet and Damp Locations: Use rigid steel or intermediate metal conduit.

G. 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.

H. Dry Locations:

1. Concealed: Use rigid steel or intermediate metal conduit, or electrical metallic tubing.
2. Exposed below 8'0" AFF or to severe physical damage: Use rigid steel or intermediate metal conduit.
3. Exposed above 8'0" AFF and not exposed to severe physical damage in unfinished spaces: Use rigid steel or intermediate metal conduit, or electrical metallic tubing .
4. In finished spaces provide surface metal raceway. In areas below 8'0" provide (2) profiled manufacturer recommended straps for each continuous section of raceway. Coordinate color selection w/ owner.

3.2 INSTALLATION

A. Install conduit in accordance with NECA "Standard of Installation."

B. Install nonmetallic conduit in accordance with manufacturer's instructions.

- C. Arrange supports to prevent misalignment during wiring installation.
- D. Support conduit using coated steel or malleable iron straps, layin adjustable hangers, clevis hangers, and split hangers.
- E. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional conduits.
- F. Fasten conduit supports to building structure and surfaces under provisions of Section 260190.
- G. Do not support conduit with wire or perforated pipe straps. Remove temporary supports.
- H. Do not attach conduit to ceiling support wires.
- I. Arrange conduit to maintain headroom and present neat appearance.
- J. Route exposed and concealed conduit parallel and perpendicular to beams, walls and floors.
- K. Route conduit installed above accessible ceilings parallel and perpendicular to walls.
- L. Route conduit in and under slab from point-to-point.
- M. Maintain adequate clearance between conduit and piping.
- N. Maintain 12-inch clearance between conduit and surfaces with temperatures exceeding 104 degrees F.
- O. Cut conduit square using saw or pipe cutter; deburr cut ends.
- P. Bring conduit to shoulder of fittings; fasten securely.
- Q. Join nonmetallic conduit using cement as recommended by manufacturer. Prepare areas to be joined with appropriate cleaner before applying cement. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
- R. Use conduit hubs to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
- S. Install no more than equivalent of three 90 degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams.
- T. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
- U. Provide suitable fittings to accommodate expansion and deflection where conduit crosses seismic, control and expansion joints.
- V. Provide suitable pull string, minimum 200 pound breaking strength, in each empty conduit except sleeves and nipples.
- W. Use suitable caps to protect installed conduit against entrance of dirt and moisture.

- X. Ground and bond conduit under provisions of Section 260170.
- Y. Identify conduit under provisions of Section 260195.
- Z. Where raceways pass through a “below grade” wall from a conditioned interior building space, said raceways shall be sealed utilizing fittings similar and equal to OZ/GEDNEY type “FSK” throughwall fitting with “FSKA” membrane clamp adapter, if required.
- AA. Terminate IMC or rigid conduit with a double locknut/bushing set or in a threaded hub.
- BB. Where concentric, eccentric or oversize knockouts are encountered while terminating conduit of any type, a bonding bushing shall be installed.
- CC. Limit the use of “LBs” to locations only absolutely necessary. Where “LBs” are used, install mogul units above 2 inch.
- DD. Supports for conduit systems shall conform to NEC minimum support requirements.
- EE. Provide a NEC sized green grounding conductor in all conduits.
- FF. Preferred method of installation in finished areas is concealed installation. Cutting and patching of existing surfaces for concealed installation is included. Where permitted by and coordinated with Architect, surface metal raceway may be installed.

3.3 INTERFACE WITH OTHER PRODUCTS

- A. Install conduit to preserve fire resistance rating of partitions and other elements.

3.2 PAINTING

- A. Prime and paint raceway to match adjacent finishes in finished areas.

END OF SECTION 260111

SECTION 260112 - SURFACE RACEWAYS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Surface metal raceways.
- B. Wireways.

1.2 SCOPE

- A. Surface mounted raceways are not acceptable unless specifically permitted by the Architect after all other options for a concealed installation have been thoroughly explored.

1.3 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specifications and other Division 260 Specification Section, apply to this Section.

1.4 REFERENCES

- A. NECA (National Electrical Contractor's Association) Standard of Installation.
- B. NEMA WD 6 - Wiring Device Configurations.

1.5 SUBMITTALS

- A. Submit under provisions of Section 260010.
- B. Product Data: Provide dimensions, knockout sizes and locations, materials, fabrication details, finishes, and accessories.
- C. Color Samples: Provide color palette for selection.
- D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with NECA Standard of Installation.
- B. Maintain one copy of document on site.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum three years of documented experience.

1.8 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by third party agencies accredited by the NCBCC to label electrical and mechanical equipment, as suitable for purpose specified and shown, where such listing exists.

PART 2 - PRODUCTS

2.1 SURFACE METAL RACEWAY

- A. Description: Sheet metal channel with fitted cover, suitable for use as surface metal raceway.
- B. Size: As shown on Drawings.
- C. Finish: Gray or Buff enamel.
- D. Fittings, Boxes, and Extension Rings: Furnish manufacturer's standard accessories.

2.2 WIREWAY

- A. Description: General-purpose type wireway or as indicated on the drawings.
- B. Knockouts: None.
- C. Size: As indicated on Drawings.
- D. Cover: Hinged cover.
- E. Connector: Flanged.
- F. Fittings: Lay-in type with removable top, bottom, and side; captive screws.
- G. Finish: Rust inhibiting primer coating with gray enamel finish.

PART 3 - EXECUTION

3.1 CONDUIT USES

- A. In finished spaces provide surface metal raceway. In areas below 8'0" provide (2) profiled manufacturer recommended straps for each continuous section of raceway.

3.2 INSTALLATION

- A. Install Products in accordance with manufacturer's instructions.
- B. Use flat-head screws, clips, and straps to fasten raceway channel to surfaces. Mount plumb and level.

- C. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.
- D. Wireway Supports: Provide steel channel as specified in Section 260190.
- E. Close ends of wireway and unused conduit openings.
- F. Ground and bond raceway and wireway under provisions of Section 260170.

3.3 ROUTING

- A. All routing of surface metal raceway shall be marked in chalk prior to installation and coordinated with the Architect. Chalk marks shall be removed after coordination meeting.
- B. Routing Guidelines
 - 1. All horizontal runs shall be at the top of the wall and feeds to wall-mounted devices shall be in vertical runs unless otherwise noted.
 - 2. Feeds to ceiling mounted devices shall follow the architectural lines of the building.

END OF SECTION 260112

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SECTION 260123 - BUILDING WIRE AND CABLE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Building wire and cable.
- B. Wiring connectors and connections.

1.2 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specifications and other Division 260 Specification Section, apply to this Section.

1.3 REFERENCES

- A. ANSI/NFPA 70 National Electrical Code.

1.4 SUBMITTALS

- A. Submit under provisions of Section 260010.
- B. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

1.5 QUALIFICATIONS

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

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by third party agencies accredited by the NCBCC to label electrical and mechanical equipment, as suitable for purpose specified and shown, where such listing exists.

1.7 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Conductors shall be copper.
- C. Wire routing shown on Drawings is approximate unless dimensioned. Route wire as required meeting Project Conditions.

- D. Where wire routing is not shown, and destination only is indicated, determine exact routing and lengths required.

1.8 COORDINATION

- A. Coordinate Work under provisions of Section 260010.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

- A. Description: Single conductor insulated wire.
- B. Insulation Voltage Rating: 600 volts.
- C. Insulation: ANSI/NFPA 70; Type XHHW or THWN/THHN insulation for feeders and branch circuits.
- D. Color Coding:

<u>Phase</u>	<u>208Y/120V</u>	<u>277/480V</u>
A	Black	Brown
B	Red	Orange
C	Blue	Yellow
Neutral	White	Natural Gray
Ground	Green	Green

- E. Wire types and sizes required in other specification sections shall supersede this section.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that mechanical work likely to damage wire has been completed.

3.2 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

3.3 WIRING METHODS

- A. All wiring shall be in raceway.
- B. Install a code-gauge green insulated grounding conductor in all raceways.

3.4 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Use solid conductors for feeders and branch circuits #10 AWG and smaller. Use Class B stranded conductors #8 AWG and larger.
- C. Use stranded conductors for control circuits.
- D. Use conductors not smaller than 12 AWG for power circuits.
- E. Use conductors not smaller than 14 AWG for control circuits.
- F. Use conductors not larger than 500 kCMIL.
- G. Use 10 AWG conductors to the first outlet for 20 ampere, 120-volt branch circuits longer than 50 feet.
- H. Use 10 AWG conductors to the first outlet for 20 ampere, 277-volt branch circuits longer than 125 feet.
- I. Pull all conductors into raceway at same time.
- J. Use suitable wire pulling lubricant for building wire 4 AWG and larger.
- K. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- L. Clean conductor surfaces before installing lugs and connectors.
- M. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- N. Joints in solid conductors shall be made using Ideal "Wirenuts, 3M Company "Scotchlocks", T&B "Piggy" or other approved insulated spring, with plastic cap, twist-on connector.
- O. Joints in stranded conductors shall be made using approved mechanical connectors and gum rubber or friction tape with an outer covering of two layers of plastic tape equal to Scotch "33+". Solderless mechanical connectors for splices and taps, provided with UL approved insulating covers, may be used in place of mechanical connectors and tape.
- P. "StaKon" or other permanent type crimp connectors shall not be used for branch circuit connections.
- Q. Voltage Drop
 - 1. 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.
 - 2. 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.

3.5 INTERFACE WITH OTHER PRODUCTS

- A. Identify wire under provisions of Section 260195.
- B. Identify each conductor with its circuit number or other designation indicated on Drawings.

3.6 FIELD QUALITY CONTROL

- A. Inspect wire for physical damage and proper connection.
- B. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.

3.7 TESTING

A. Feeder Insulation Resistance Testing

1. Test all current carrying phase conductors and neutrals as installed, and before connections are made, for insulation resistance and accidental grounds. This shall be done with a 500-volt cable insulation tester. The testing procedures listed below shall be followed:
- B. Minimum readings shall be one million (1,000,000) or more ohms for #6 AWG and smaller wire and 250,000 ohms or more for #4 AWG or larger wire, between phase and neutral conductors, and between phase and neutral conductors and the grounding conductor.
 - C. After all devices and equipment are installed and all connections are completed to each panel, the contractor shall disconnect the neutral feeder conductor from the neutral bar and take a cable insulation tester 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 conductors from this neutral bar. He shall then test each one separately to the panel until the low readings are found. The contractor shall correct the problems, reconnect and retest the wires until at least 250,000 ohms from the neutral bar to the grounded panel can be achieved with only the neutral feeder disconnected.
 - D. The contractor shall send a letter to the Engineer certifying that the above test has been done, and tabulating the cable insulation tester readings for each panel. This shall be done at least four (4) days prior to final inspection.

E. Ground System Testing

1. Upon completion of installation the electrical grounding and bonding systems, test the ground resistance with a ground resistance tester. Where tests show resistance to ground is over 25 ohms, drive additional ground rods as necessary to reduce the ground resistance to 25 ohms or less. Retest to demonstrate that the resistance is less than or equal to 25 ohms.

F. Documentation

1. All tests specified shall be completely documented indicating time of day, date, temperature and all pertinent test information.
2. At the final inspection, the contractor shall furnish a megger and show the Engineer and local AHJ that the panels comply with the above requirements. He will also furnish a

clamp-on type ammeter and a voltmeter and take current and voltage readings as directed by the Engineer and AHJ.

3. All required documentation of readings indicated above shall be submitted to the Engineer prior to, and as one prerequisite for, the final acceptance of the project.

END OF SECTION 26 01 23

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SECTION 260130 - BOXES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Wall and ceiling outlet boxes.
- B. Pull and junction boxes.

1.2 1.2 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specifications and other Division 260 Specification Section, apply to this Section.

1.3 1.3 REFERENCES

- A. NECA Standard of Installation.
- B. NEMA FB 1 Fitting and Supports for Conduit and Cable Assemblies.
- C. NEMA OS 1 Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
- D. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum).
- E. NFPA 70 National Electrical Code.

1.4 SUBMITTALS FOR CLOSEOUT

- A. Record actual locations and mounting heights of outlet, pull, and junction boxes on project record documents.

1.5 1.5 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Provide Products listed and classified by third party agencies accredited by the NCBCC to label electrical and mechanical equipment, as suitable for the purpose specified and indicated, where such listing exists.

PART 2 - PRODUCTS

2.1 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
 - 1. Equipment Supporting Boxes: Rated for weight of equipment supported; include ½" male fixture studs where required.
- B. Nonmetallic Outlet Boxes: NEMA OS 2.
- C. Cast Boxes: NEMA FS, Type FD, cast fer alloy. Provide gasketed cover by box manufacturer. Provide threaded hubs.
- D. Wall Plates for Finished Areas: As specified in Section 260141.

2.2 PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
- B. Surface Mounted Cast Metal Box: NEMA 250, Type 4 or 6; flatflanged, surface mounted junction box:
 - 1. Material: Galvanized cast iron or cast aluminum.
 - 2. Cover: Furnish with ground flange, neoprene gasket, and stainless-steel cover screws.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify locations of floor boxes and outlets prior to roughin.

3.2 3.2 INSTALLATION

- A. Install boxes in accordance with NECA "Standard of Installation."
- B. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.
- C. Set wall mounted boxes at elevations to accommodate mounting heights as indicated or as specified in section for outlet device.
- D. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Adjust box location up to 10 feet if required to accommodate intended purpose.
- E. Orient boxes to accommodate wiring devices oriented as specified in Section 260141.

- F. Maintain headroom and present neat mechanical appearance.
- G. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- H. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
- I. Install boxes to preserve fire resistance rating of partitions and other elements, using specified materials and methods.
- J. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- K. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.
- L. Use flush mounting outlet box in finished areas.
- M. Do not install flush mounting box back-to-back in walls; provide minimum 24 inches separation.
- N. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- O. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- P. Do not fasten boxes to ceiling support wires.
- Q. Support boxes independently of conduit.
- R. Use cast boxes in exterior and wet locations such as bathrooms.
- S. Large Pull Boxes: Use hinged enclosure in interior dry locations, surfacemounted cast metal box in other locations.

3.3 3.3 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate installation of outlet box for equipment with corresponding trade.

3.4 ADJUSTING

- A. Adjust flush-mounted outlets to make front flush with finished wall material.
- B. Install knockout closures in unused box openings.

3.5 3.5 CLEANING

- A. Clean interior of boxes to remove dust, debris, and other material.
- B. Clean exposed surfaces and restore finish.

3.6 PAINTING

- A. Prime and paint raceway to match adjacent finishes in finished areas.

END OF SECTION 260130

SECTION 260141 - WIRING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Wall switches.
- B. Wall dimmers.
- C. Receptacles.
- D. Device plates and decorative box covers.

1.2 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specifications and other Division 260 Specification Section, apply to this Section.

1.3 REFERENCES

- A. NEMA WD 1 General Purpose Wiring Devices.
- B. NEMA WD 6 Wiring Device Configurations.

1.4 SUBMITTALS

- A. Submit under provisions of Section 260010.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
- C. Manufacturer's Instructions:
 - 1. Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements.
 - 2. Include instructions for storage, handling, protection, examination, preparation, operation and installation of product.

1.5 QUALIFICATIONS

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

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.

- B. Furnish products listed and classified by third party agencies accredited by the NCBCC to label electrical and mechanical equipment, as suitable for purpose specified and shown, where such listing exists.

1.7 EXTRA MATERIALS

- A. Provide two of each style, size, and finish wall plate.

PART 2 - PRODUCTS

2.1 RECEPTACLES

- A. Description: NEMA WD 1; heavy duty, specification grade receptacle.
- B. Device Body: Verify color with the Architect before ordering.
- C. Duplex receptacles shall be of the grounding type, arranged for back and side wiring, with separate single or double grounding terminals. Receptacles shall be straight blade, rated 20 amps, 125 volt and the face configuration shall conform to the NEMA Standard No. WDI.101968. Self-grounding or automatic type grounding receptacles are not acceptable in lieu of receptacles with separate grounding screw lugs and a direct, green insulated conductor connection to the equipment grounding system.
- D. Receptacles shall be industrial specification or heavy-duty grade, mounted vertically. Receptacles mounted over counters, back-splashes, etc., shall be mounted horizontally.
- E. Special wiring devices shall be shown on the drawings with complete description thereof.
- F. GFCI receptacles shall be rated minimum 20 amp (NEMA 5-20R configuration).
- G. GFCI receptacles shall be provided where installed to serve countertop and are located within 6 feet of a sink.

2.2 WALL SWITCHES

- A. Manufacturers:
 - 1. Hubbell.
 - 2. Legrand.
 - 3. Leviton.
- B. Description: NEMA WD 1, heavy duty, AC only general use snap switch, single-pole, three-way or for-way as indicated on the drawings.
- C. Device Body: Verify color with the Architect before ordering.
- D. Voltage Rating: 120/277 volts, AC.
- E. Current Rating: 20 amperes.
- F. Shall have quiet operating mechanisms without the use of mercury switches.

- G. Lighted handle switches shall have neon lights of the correct voltage as indicated on the drawings.
- H. Grounding: Switches shall contain one or two separate green, hex head grounding screw(s). Switches without factory installed grounding screws are not acceptable.

2.3 WALL DIMMERS

- A. Manufacturers:
 - 1. Hubbell.
 - 2. Eagle.
 - 3. Leviton.
 - 4. Substitutions: Under provisions of Section 01600.
- B. Description: NEMA WD 1, semiconductor dimmer for incandescent lamps, type as indicated on the Drawings.
- C. Device Body: Verify color with the Architect before ordering.
- D. Voltage: 120 [277] volts.
- E. Power Rating: Match load shown on Drawings; 600 Watts minimum.

2.4 WALL PLATES

- A. Cover plates for flush mounted wiring devices and for telephone outlets shall be Type "302" stainless steel type, standard size, single or ganged as shown on the drawings. Cover plate mounting screws shall be slotted head oval screws, shall match the finish and material of the plate, and shall be furnished with the plate by the plate manufacturer. Quantity of 2% spare cover plates of each type shall be provided to the owner.
- B. Switch and receptacle cover plates on exposed work in unfinished areas may be galvanized cast ferrous metal or Feraloy, standard size, and shall be single or ganged as indicated on the drawings.
- C. Weatherproof Cover Plate: Exterior mounted switch and receptacle plates, and those noted to be weatherproof, shall be weatherproof PVC 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."
- D. Provide a quantity of 2% of each type of installed cover plates of to the owner.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify conditions.
- B. Verify outlet boxes are installed at proper height.

- C. Verify wall openings are neatly cut and will be completely covered by wall plates. Provide larger plates as necessary to cover oversize holes.
- D. Verify floor boxes are adjusted properly.
- E. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 PREPARATION

- A. Provide extension rings as necessary to bring outlet boxes flush with finished surface.
- B. Clean debris from outlet boxes.

3.3 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install devices plumb and level.
- C. Install receptacles with grounding pole on top.
- D. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.
- E. Install decorative plates on receptacle outlets in finished areas.
- F. Connect wiring devices by wrapping conductor around screw terminal.
- G. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Install convenience receptacle 16 inches to bottom of box above finished floor.

3.5 FIELD QUALITY CONTROL

- A. Inspect each wiring device for defects.
- B. Verify that each receptacle device is energized.
- C. Test each receptacle device for proper polarity.
- D. Test each GFCI receptacle device for proper operation.

3.6 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

END OF SECTION 260141

SECTION 260160 - CABINETS AND ENCLOSURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Hinged cover enclosures.
- B. Cabinets.
- C. Terminal blocks.
- D. Accessories.

1.2 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specifications and other Division 260 Specification Section, apply to this Section.

1.3 REFERENCES

- A. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- B. NEMA ICS 4 - Terminal Blocks for Industrial Control Equipment and Systems.
- C. ANSI/NFPA 70 - National Electrical Code.

1.4 SUBMITTALS

- A. Submit under provisions of Section 260010.
- B. Product Data: Provide manufacturer's standard data for enclosures and cabinets.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.5 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by third party agencies accredited by the NCBCC to label electrical and mechanical equipment, as suitable for purpose specified and shown, where such listing exists.

1.6 EXTRA MATERIALS

- A. Furnish under provisions of Section 260010.
- B. Provide two of each cabinet key.

PART 2 - PRODUCTS

2.1 HINGED COVER ENCLOSURES

- A. Construction: Steel enclosure.
 - 1. Interior Dry Locations in Production Areas: NEMA 250 Type 12.
 - 2. Interior Dry Locations in Non-Production Areas: NEMA 250 Type 1.
 - 3. Exterior, Wet and Damp Locations: NEMA 250 Type 3R.
- B. Covers: Continuous hinge, held closed by flush latch operable by screwdriver
- C. Provide interior metal panel for mounting terminal blocks and electrical components; finish with white enamel.
- D. Enclosure Finish: Manufacturer's standard enamel.

2.2 CABINETS

- A. Boxes: Galvanized steel.
- B. Box Size: Sized per the NEC.
- C. Backboard: Provide 3/4-inch-thick plywood backboard for mounting terminal blocks. Paint matte white.
- D. Fronts: Steel, flush or surface type, as shown on the drawings, with screw cover front, concealed hinge, and flush lock keyed to match branch circuit panelboard. Finish with gray baked enamel.
- E. Knockouts: None.
- F. Provide metal barriers to separate compartments containing control wiring operating at less than 50 volts from power wiring.
- G. Provide accessory feet for free-standing equipment.

2.3 TERMINAL BLOCKS

- A. Terminal Blocks: ANSI/NEMA ICS 4.
- B. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.
- C. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts.
- D. Provide ground bus terminal block, with each connector bonded to enclosure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify conditions under provisions of Section 260010.
- B. Verify that surfaces are ready to receive Work.

3.2 INSTALLATION

- A. Install Products in accordance with manufacturer's instructions.
- B. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner.
- C. Install cabinet fronts plumb.

END OF SECTION 260160

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SECTION 260170 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Grounding electrodes and conductors.
- B. Equipment grounding conductors.
- C. Bonding.

1.2 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specifications and other Division 260 Specification Section, apply to this Section.

1.3 SCOPE

- A. Verify and bring existing conditions into compliance with the grounding and bonding specified in this section.

1.4 REFERENCES

- A. ANSI/NFPA 70 National Electrical Code.

1.5 GROUNDING ELECTRODE SYSTEM

- A. Metal underground water pipe.
- B. Metal frame of the building.
- C. Rod electrode.

1.6 PERFORMANCE REQUIREMENTS

- A. Grounding System Resistance: 25 ohms.

1.7 SUBMITTALS

- A. Submit under provisions of Section 260010.
- B. Product Data: Provide data for grounding electrodes and connections.
- C. Test Reports: Indicate overall resistance to ground and resistance of each electrode.
- D. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation and installation of exothermic connectors.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum three years documented experience.

1.9 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by third party agencies accredited by the NCBCC to label electrical and mechanical equipment, as suitable for purpose specified and shown, where such listing exists.

PART 2 - PRODUCTS

2.01 ROD ELECTRODE

- A. Material: Copper clad steel.
- B. Diameter: 3/4 inch.
- C. Length: 10 feet.

2.2 MECHANICAL CONNECTORS

- A. Material: Bronze.

2.3 WIRE

- A. Material: Stranded copper.
- B. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.2 INSTALLATION

- A. Install Products in accordance with manufacturer's instructions.
- B. Install rod electrodes at locations indicated. Install additional rod electrodes as required to achieve specified resistance to ground.
- C. Provide bonding to meet Regulatory Requirements.

- D. Equipment Grounding Conductor: Provide a separate, green insulated conductor within each raceway, sized per NEC Table 250-122. Terminate each end on suitable lug, bus, or bushing.
- E. Where conduits are terminated in concentric, eccentric or oversize knockouts, terminate conduit with a bonding bushing and a green or bare grounding jumper, sized per NEC Table 250.102(C)(1)95, to the ground bar.

3.3 SERVICE GROUNDING

- A. The electrical service shall be grounded by three (3) means:
 - 1. To the metallic cold-water pipe, as per NEC Article 250-50.
 - 2. To the steel frame of the building, provided the building frame is effectively grounded.
 - 3. To ground rod(s). Ground rods shall be 10 feet long and 3/4 inch in diameter and shall be of copper-clad steel construction.
 - 4. All ground connections shall be accessible.

3.4 FIELD QUALITY CONTROL

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
- B. Use suitable test instrument to measure resistance to ground of system. Perform testing in accordance with Section 260123 Building Wire and Cable.

END OF SECTION 260170

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SECTION 260190 - SUPPORTING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Conduit and equipment support.
- B. Anchors and fasteners.

1.2 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specifications and other Division 260 Specification Section, apply to this Section.

1.3 REFERENCES

- A. NECA National Electrical Contractors Association.
- B. ANSI/NFPA 70 National Electrical Code.

1.4 SUBMITTALS

- A. Submit under provisions of Section 260010.
- B. Product Data: Provide manufacturer's catalog data for fastening systems.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation and starting of Product.

1.5 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by third party agencies accredited by the NCBCC to label electrical and mechanical equipment, as suitable for purpose specified and shown, where such listing exists.

PART 2 - PRODUCTS

2.1 PRODUCT REQUIREMENTS

- A. Materials and Finishes: Provide adequate corrosion resistance.
- B. Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.
- C. Anchors and Fasteners:

1. Toggle bolts on hollow masonry.
2. Metal expansion shields and machine screws, or standard pre-set inserts on concrete or solid masonry.
3. Machine screws or bolts on metal surfaces.
4. Wood screws on wood construction.

2.2 CHANNEL AND SUPPORT SYSTEMS

- A. Channel and angle support systems, hangers, anchors, sleeves, brackets, fabricated items and fasteners, shall be designed to provide secure support from the building structure, for electrical components.
- B. Description:
 1. Steel, unless otherwise noted shall be protected from corrosion with zinc coating, or with a treatment of equivalent corrosion resistance, using approved alternative finish or inherent material characteristics.
 2. Metal items for outdoor or damp location use shall be hot-dip galvanized steel, unless otherwise noted.
 3. Steel channel shall have 9/16-inch diameter holes at a maximum of 8 inches on center, in at least one surface.
 4. Fittings and accessories for steel channel shall match and mate and be from the same manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions in unfinished spaces only.
- B. Conceal supports in finished spaces.
- C. Provide anchors, fasteners, and supports in accordance with NECA "Standard of Installation".
- D. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.
- E. Obtain permission from Engineer before using powder actuated anchors.
- F. Do not drill or cut structural members.
- G. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
- H. Install surface mounted cabinets and panelboards with minimum of four anchors.
- I. In wet and damp locations use steel channel supports to stand cabinets and panelboards one inch off wall.
- J. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

- K. Conduits installed on the interior side of exterior walls shall be spaced a minimum of 1/4" off the walls.
- L. Conduit hangers shall not be used below 8' on walls to avoid snagging of clothing articles and other injuries. Use conduit straps and bent offsets as needed for exposed terminations.

END OF SECTION 260190

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SECTION 260195 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Nameplates and labels.
- B. Wire and cable markers.
- C. Conduit markers.

1.2 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specifications and other Division 260 Specification Section, apply to this Section.

1.3 REFERENCES

- A. ANSI/NFPA 70 National Electrical Code.

1.4 SUBMITTALS

- A. Submit under provisions of Section 260010.
- B. Product Data: Provide catalog data for nameplates, labels, and markers.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation and installation of Product.

1.5 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by third party agencies accredited by the NCBCC to label electrical and mechanical equipment, as suitable for purpose specified and shown, where such listing exists.

PART 2 - PRODUCTS

2.1 NAMEPLATES AND LABELS

- A. Nameplates: Furnish and install engraved laminated phenolic nameplates for all safety switches, panelboards, transformers, switchboards, motor control centers and other electrical equipment supplied for the project for identification of equipment, controlled, served, phase, voltage, etc. Nameplates shall be securely attached to equipment with pop-rivets of suitable material and size, and shall identify equipment controlled, attached, etc. Letters shall be 1/2-

inch-high minimum. Embossed and printed self-adhesive plastic tape is not acceptable for marking equipment. Nameplate material colors shall be:

1. Fire Alarm System:	Bright red surface with white core
2. Telephone/Data System:	Orange surface with white core
3. Sound System:	Dark Blue with white core
4. Security System:	Dark red (burgundy) surface with white core
5. Emergency System:	Green surface with white core
6. Data Systems:	Brown surface with white core
7. Paging System:	White surface with black core
8. TV System:	Purple surface with white core
9. 208 Volt System:	Blue surface with white core
10. 480 Volt System:	Black surface with white core

B. Locations:

1. Each safety switch, panelboard, transformer, switchboard, main feeder circuit breakers and other electrical equipment supplied for the project. Information on the nameplate shall include; equipment controlled and/or served, phase and voltage.

C. Letter Size: Minimum of 1/2 inch.

D. Labels: Printed adhesive tape, with 3/8-inch black letters on transparent background. Use only for identification of individual wall switches and receptacles with their corresponding electrical panel and breaker numbers.

E. Label Information: Equipment controlled and/or served - voltage, phase, etc.

2.2 WIRE MARKERS

A. Description: Cloth, tape, split sleeve, or tubing type wire markers.

B. Locations: Each conductor at panelboard gutters, pull boxes, outlet and junction boxes and each load connection.

C. Legend:

1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.

2.3 CONDUIT MARKERS

A. Location: Furnish markers for each conduit longer than 20 feet.

B. Color:

1. Fire Alarm System:	Bright Red.
2. Telephone/Data System:	Orange
3. Sound System:	Dark Blue.
4. Security	Dark Red (Burgundy)
5. Emergency Systems	Green
6. Data Systems	Brown

7.	Paging Systems	White
8.	TV Systems:	Purple
9.	208 Volt System:	Blue.
10.	480 Volt System:	Black.

- C. As an alternative to the above requirements, conduit in unfinished areas may be marked with spray paint.
- D. 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.

2.4 UNDERGROUND WARNING TAPE

- A. Description: 6-inch-wide, 4 mils thick, plastic tape, detectable type, bright colored with suitable warning legend, continuously printed, describing buried electrical lines.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive nameplates and labels.

3.2 APPLICATION

- A. Install nameplates and labels parallel to equipment lines.
- B. Secure nameplate to equipment front using self-tapping stainless-steel screws.
- C. Paint colored band on each conduit longer than 20 feet, 20 feet on center.
- D. Junction and pull boxes in conduit runs shall have their covers and exterior surfaces painted to match the colors in 2.3B above. This includes covers on boxes above lift-out and other type accessible ceilings.
- E. Identify all underground conduits using underground warning tape. Install one tape per trench at 6 to 8 inches below finished grade.
- F. Empty conduits and conduits with conductors, for future use shall be identified for use and shall indicate on each end where they terminate. Identification shall be by tags with string or wire attached to the conduit or outlet.

END OF SECTION 260195

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SECTION 260289 – SURGE PROTECTION DEVICE (SPD)

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Transient voltage surge suppression devices and accessories.

1.2 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specifications and other Division 26 Specification Section, apply to this Section.
- B. Section 26 08 00 - Commissioning of Electrical

1.3 REFERENCES

- A. Institute of Electrical and Electronic Engineers (IEEE) C62.41 and C62.45
- B. Federal Information Processing Standard Publication (FIPS) PUB 94
- C. National Electrical Manufacturers Association (NEMA) LS 1
- D. National Fire Protection Association (NFPA) 20, 70, 75, and 78
- E. Underwriters Laboratories (UL) 1449, current edition

1.4 SYSTEM DESCRIPTION

- A. A high-energy surge protection system that provides effective high energy surge current diversion and is suitable for application in ANSI/IEEE C62.41 Category A, B, and C environments, as tested by ANSI/IEEE C62.11, C62.45.

1.5 SUBMITTALS

- A. Submit under provisions of Section 260010.
- B. Shop Drawings: Provide system-wiring diagram showing each device and wiring connection required.
- C. Product Data: Provide electrical characteristics and connection requirements.
- D. UL 1449 Ratings -- Documentation of specified system's UL 1449 listing and clamping voltage ratings shall be included as required product submittal information.
- E. Test Reports: Indicate satisfactory completion of required tests and inspections.
- F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.6 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 260010.
- B. Record actual locations of SPD equipment.

1.7 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 260010.
- B. Operation Data: Operating instructions.
- C. Maintenance Data: Maintenance and repair procedures.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience, and with service facilities within 100 miles of Project.
- B. Installer: Company specializing in installing standard SPD systems for a minimum of three years.

1.9 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by third party agencies accredited by the NCBCC to label electrical and mechanical equipment, as suitable for purpose specified and shown, where such listing exists.
- C. The system's individual units shall be UL listed under UL 1449 Standard for Surge Protection Devices (SPD) and the surge ratings shall be permanently affixed to the SPD.

1.10 MAINTENANCE SERVICE

- A. Furnish service and maintenance of security access system for one year from Date of Substantial Completion.

1.11 WARRANTY

- A. The manufacturer shall provide a full five-year warranty from date of shipment against any part failure when installed in compliance with manufacturer's written instructions, UL listing requirements, and any applicable national or local electrical code. Manufacturer shall make available (local, national) field engineering service support. Where direct factory-employed service engineers are not locally available, travel time from the factory or nearest dispatch center shall be stated.

1.12 QUALITY ASSURANCE

- A. The specified system shall be thoroughly factory-tested before shipment. Testing of each system shall include but shall not be limited to quality control checks, dielectric voltage with stand tests at twice rated voltage plus 1000 volts per UL requirements, IEEE C62.41 Category B surge tests, UL ground leakage tests, and operational and calibration tests

PART 2 - PRODUCT

2.1 ENVIRONMENTAL REQUIREMENTS

- A. Storage temperature range shall be -55 to +85 C (-67 to +187 F).
- B. Operating temperature range shall be -40 to +50 C (-40 to +122 F).
- C. Operation shall be reliable in an environment with 0% to 95% non-condensing relative humidity.
- D. The audible noise level of the specified system shall be less than 45 dBA at 5 feet (1.5 m).
- E. The system shall be capable of operation up to an altitude of 12,000 feet above sea level.

2.2 The nominal system operating voltage shall be: 480 volts, three phase, four wire plus ground.

2.3 The SPD maximum continuous operating voltage (MCOV) shall be greater than 115% of the nominal systems operating voltage to ensure the ability of the system to withstand temporary RMS over voltage (swell) conditions.

2.4 The operating frequency range of the system shall be at least 47 to 63 Hertz.

2.5 The system shall provide up to 45 amp of Harmonic Sink Current capability.

2.6 *All protection modes of the SPD shall be internally fused at the component level with the fuses I²T capability to allow the suppressor's maximum rated transient current to pass through the suppressor without fuse operation. If the rated I²T characteristic of the fusing is exceeded, the fusing shall be capable of opening in less than one millisecond and clear both high and low impedance fault conditions. The fusing shall be capable of interrupting up to 300 kA symmetrical fault current with 600 VAC applied. This overcurrent protection circuit shall be monitored and provide indication of suppression failure/operability.

2.7 *The SPD shall provide protection as follows:

- A. All Modes. L-N or L-L, L-G, (N-G where applicable)

Note: L = Line, N = Neutral, G = Ground

2.8 Performance Ratings

- A. The SPD surge current capacity, based on an 8 x 20 microsecond waveform shall be:

<u>PHASE</u>	<u>L-G</u>	<u>L-L</u>	<u>L-N</u>	<u>N-G</u>
Three-Phase Wye	200 kA	200 kA	200 kA	400 kA

- B. *The system performance ratings shall be based on UL 1449 listing ratings for IEEE C62.45 Category B3 impulse waveforms of 6 KV 1.2 x 50 microseconds, 3 KA, 8 x 20 microseconds wave shapes. The maximum UL 1449 listed surge rating for each and/or all of the specified protection modes shall not exceed:
1. 400 Volts for 120, 120/208, or 120/240-volt systems.
 2. 800 Volts for 208, 240, 277, 220/380, 240/415 or 277/480 volt systems.
 3. 1200 Volts for 346 or 346/600-volt systems.
 4. 1500 Volts for 480-volt systems.
 5. 2000 Volts for 600-volt systems.
- C. Typical Remnant Voltage (Category C) Tests demonstrating clamping voltage following procedures established in ANSI/IEEE C62.45, and C62.41, 10 KA 8 X 20 microseconds surge current shall be:

<u>System Nominal Voltage</u>	<u>Remnant Voltage</u> <u>C3 Model</u>	<u>Remnant Voltage</u> <u>C2 Model</u>	<u>Remnant Voltage</u> <u>C1 Model</u>
120, 120/208 or 120/240 Volts	472 V	522 V	590 V
208 volts	695 V	715 V	820 V
240, 277 or 277/480 Volts	850 V	910 V	980 V
346 or 346/600 Volts	1120 V	1200 V	1310 V
480 Volts	1340 V	1440 V	1500 V
600 Volts	1540 V	26040 V	1750 V

- 2.9 The SPD system shall provide a joule rating that meets or exceeds the requirements of ANSI/IEEE C62.41 Category C3 delivery capability.
- 2.10 All mode systems shall provide noise attenuation for electrical line noise of 40 dB per 50 ohm measurement method for from 10 KHz through 50 MHz, through the use of 120 micro farad capacitors connected L-L in Delta and L-n in Wye systems.
- 2.11 Typical response time of all suppression components shall be .5 nanoseconds.
- 2.12 The typical remnant voltage of the SPD modules when subjected to a 20 KV, 1.2 x 50/10 KA, 8 x 20 microseconds surges shall be less than 1081 Vp for systems up to 277/480 V.
- 2.13 DOCUMENTATION
- A. Equipment Manual -- The manufacturer shall furnish an installation manual with installation, startup, parts lists, and operating instructions for the specified system.
 - B. Drawings - Electrical and mechanical drawings shall be provided by the manufacturer which show unit dimensions, weights, component and connection locations, mounting provisions, connection details, and wiring diagram(s).
- 2.14 Surge Suppression Components
- A. The system shall be constructed using multiple surge current diversion modules, each rated for at least 40 KA single occurrence and 10 surges at 25 KA of surge current capacity based on the standard 8 x 20 microseconds waveform. Each module shall be capable of withstanding over 1,000 pulses of the 10 KA IEEE 62.41 Category C3 surge current without failure when tested per C62.45 suggested wait

times. Each module shall be individually fused. The status of each module shall be monitored and a green LED shall be illuminated if the module is in full working order. When module performance is degraded, such as if one or more fuse, or other component having failed, the LED shall indicate a failed module. All protection modules, including the N - G, shall be internally fused and monitored.

- 2.15 CONNECTIONS -- Terminals shall be provided for all necessary power and ground connections. The terminals shall accommodate wire sizes of #14 to #2/0 AWG for two conductors per required connection, thereby allowing a Kelvin connection of SPD which minimizes the actual suppressed voltage at the protected circuit for SPD's up to 150 A. Above 150 A the units shall use standard parallel wiring techniques.
- 2.16 INTERNAL CONNECTIONS AND SERVICEABILITY -- All surge current diversion module intra-unit connections shall be by way of low impedance plated bus bars. No small gauge round wire or plug-in connections to the plated bus bars shall be used, to insure reliable low impedance connections. All module mounting hardware and power wiring shall be captive or remain in place when a module is removed or replaced. The system shall be designed for simple change out of any or all SPD component modules by a qualified electrician. Designs which require layers of disassembly, or which require factory service do not meet the requirement.
- 2.17 ENCLOSURE (Selection Required) -- The specified system shall be provided in a heavy duty NEMA 12 dust-tight, drip-tight enclosure with no ventilation opening. The cover of the enclosure shall be hinged on the left side and require a tool for access to internal components. A drawing pocket shall be provided inside the door for storage of unit drawings and installation/operation manual. Indication of surge current module status shall be visible without opening the door.
- 2.18 ACCESSORIES
- A. Unit Status Indicators -- Red and green solid-state indicators with printed labels shall be provided on the front cover to repeatedly indicate unit module status. The absence of the green light and the presence of the red light shall reliably indicate that one or more surge current diversion modules has failed and that service is needed to restore full operation. Additionally, a electrically isolate Form C (one N.O. and one N.C.) summary alarm contact rated for at least 120 VAC and 1 ampere shall be provided for remote annunciation of unit status. The summary alarm contact shall change state if any one or more of the surge current diversion modules has failed.
 - B. The specified system shall be equipped with an audible alarm, which shall be activated when any one or more of the surge current diversion modules has failed. In conjunction with the audible alarm, an alarm on, off switch shall be provided to silence the alarm and an alarm push-to-test switch shall be provided to test the alarm function. Both switches and the audible alarm shall be located on the unit's hinged front cover.
 - C. A transient voltage surge counter shall be included to totalize transient voltage surges, which deviate from the sine wave envelope by more than 125 volts. The readout shall be at least a six digit LCD located on the unit's hinged front cover. The counter shall be equipped with a battery back up to retain memory when power is not present. A push-button switch on the display's faceplate shall be provided for manual counter reset.
 - D. A self-contained, UL listed, monitoring panel shall be available to allow remote annunciation of the system status. Input power to the monitoring panel shall be equipped with a 6 foot long input power cord with a NEMA 5-15P plug. The monitor panel shall have an audible alarm, red and green LED's, an alarm on/off switch to silence, and a push-to-test alarm switch. The monitor panel shall connect to a specified surge suppression system by way of a two-wire control cable. Under normal operation the green LED shall be illuminated. Upon correction of module failure, the monitor panel shall automatically reset to normal mode. The panel shall be a non-conductive enclosure.

- E. Service Disconnect Switch: If the specified SPD system is not served from an external circuit breaker in a panelboard or switchboard, then it shall include a circuit breaker/disconnect switch located within the SPD system enclosure, with an external manual operator. The switch shall disconnect all ungrounded circuit conductors from the high-energy surge current diversion modules. The switch shall be rated for 600 VAC and 30 amps (minimum) continuous. Wiring terminations shall be provided for at least #8 AWG.

PART 3 - EXECUTION

- 3.1 Install the parallel SPD with as short and straight conductors as practically as possible.
- 3.2 The type 2 SPD shall be installed on the load side of the overcurrent protective device. SPD category "C" shall be mounted at the service equipment, category "B" shall be mounted at the branch panel and category "A" shall be mounted at the load.
- 3.3 Twist the SPD input conductors together to reduce input conductor inductance.
- 3.4 Follow the SPD manufacturer's recommended installation practices and comply with all applicable codes.
- 3.5 The manufacturer shall provide an annual maintenance proposal.

END OF SECTION 260289

SECTION 260441 - ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fusible switches.
- B. Non-fusible switches.
- C. Fuses.

1.2 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specifications and other Division 260 Specification Section, apply to this Section.
- B. Section 26 08 00 - Commissioning of Electrical

1.3 REFERENCES

- A. NEMA KS 1 Enclosed Switches.
- B. NFPA 70 National Electrical Code.
- C. UL 198C High Interrupting Capacity Fuses; Current Limiting Type.
- D. UL 198E Class R Fuses.

1.4 SUBMITTALS

- A. Submit under provisions of Section 260010.
- B. Product Data: Provide switch ratings and enclosure dimensions.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with NECA Standard of Installation.
- B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum three years documented experience.

1.7 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by third party agencies accredited by the NCBCC to label electrical and mechanical equipment, as suitable for purpose specified and shown, where such listing exists.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Square D.
- B. Westinghouse.
- C. General Electric.
- D. Siemens/ITE
- E. Substitutions: Under provisions of Section 260010.

2.2 ENCLOSED SWITCHES

- A. Fusible Switch Assemblies: NEMA KS 1, Type HD (Heavy Duty) load interrupter enclosed knife switch with externally operable handle interlocked (with defeat mechanism) to prevent opening front cover with switch in ON position. Handle lockable in ON or OFF position. Fuse clips: Designed to accommodate Class R fuses.
- B. Nonfusible Switch Assemblies: NEMA KS 1, Type HD (Heavy Duty) load interrupter enclosed knife switch with externally operable handle interlocked (with defeat mechanism) to prevent opening front cover with switch in ON position. Handle lockable in ON or OFF position.
- C. Enclosures: NEMA KS 1.
 - 1. Interior Dry Locations in Production Areas: NEMA 250 Type 12.
 - 2. Interior Dry Locations in Non-Production Areas: NEMA 250 Type 1.
 - 3. Exterior, Wet and Damp Locations: NEMA 250 Type 3R.
- D. Switches 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.
- E. Switches shall have nontearable, positive, quick make-quick break mechanisms.
- F. General duty switches are not acceptable.

2.3 FUSES

- A. Manufacturers:
 - 1. Bussmann

2. Reliance
 3. Substitutions: Under provisions of Section 260010.
- B. Description: Dual element, current limiting, time delay, voltage as indicated on the Drawings, UL 198E, Class RK 5 unless noted otherwise on the Drawings.
- C. Interrupting Rating: 200,000 RMS amperes.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install disconnect switches where indicated.
- B. Install fuses in fusible disconnect switches.
- C. Label switches per Section 26 01 95 Electrical Identification.
- D. Provide adhesive label on inside door of each switch indicating UL fuse class and size for replacement.

END OF SECTION 260441

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SECTION 260470 - PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Distribution panelboards.
- B. Branch circuit panelboards.

1.2 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specifications and other Division 260 Specification Section, apply to this Section.

1.3 REFERENCES

- A. NECA (National Electrical Contractors Association) "Standard of Installation."
- B. NEMA AB 1 Molded Case Circuit Breakers.
- C. NEMA ICS 2 Industrial Control Devices, Controllers, and Assemblies.
- D. NEMA KS 1 Enclosed Switches.
- E. NEMA PB 1 Panelboards.
- F. NEMA PB 1.1 Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or less.
- G. NFPA 70 National Electrical Code.

1.4 SUBMITTALS

- A. Submit under provisions of Section 260010.
- B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.
- C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.5 PROJECT RECORD DOCUMENTS

- A. Record actual locations of Products; indicate actual branch circuit arrangement.

1.6 OPERATION AND MAINTENANCE DATA

- A. Maintenance Data: Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with NECA Standard of Installation.
- B. Maintain one copy of each document on site.

1.8 QUALIFICATIONS

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

1.9 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by third party agencies accredited by the NCBCC to label electrical and mechanical equipment, as suitable for purpose specified and indicated, where such listing exists.

1.10 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings and as instructed by manufacturer.

1.11 MAINTENANCE MATERIALS

- A. Provide two of each panelboard key.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Square D.
- B. Eaton.
- C. General Electric.
- D. Siemens.

2.2 DISTRIBUTION PANELBOARDS

- A. Panelboards: NEMA PB 1, circuit breaker type.
- B. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard.
- C. Minimum integrated short circuit rating: 10,000 amperes RMS symmetrical for 240 volt panelboards; 14,000 amperes RMS symmetrical for 480 volt panelboards, or as indicated.

- D. Molded Case Circuit Breakers: NEMA AB 1. Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Circuit breakers shall have a minimum temperature rating of 75° C. Circuit breakers shall be bolt-in type.
- E. Current Limiting Molded Case Circuit Breakers: NEMA AB 1. Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole, Interrupting rating 100,000 symmetrical amperes, letthrough current and energy level equal to or less than permitted for same size Class RK5 fuse. Circuit breakers shall have a minimum temperature rating of 75° C. Circuit breakers shall be bolt-in type.
- F. Enclosure: NEMA PB 1, Type 1 for interior locations; Type 3R for exterior, wet or damp locations.
- G. Cabinet Front: Surface type, fastened with concealed trim clamps. Provide hinged door-on-door with flush lock. Finish in manufacturer's standard gray enamel.
- H. Circuit Breakers 400 Amp and larger shall have an adjustable LSI electronic trip element.

2.3 BRANCH CIRCUIT PANELBOARDS

- A. Lighting and Appliance Branch Circuit Panelboards: NEMA PB1, circuit breaker type.
- B. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard; provide insulated ground bus where scheduled.
- C. Minimum integrated short circuit rating: 10,000 amperes RMS symmetrical for 240 volt panelboards; 14,000 amperes RMS symmetrical for 480 volt panelboards, or as indicated.
- D. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled and per NEC requirements. Do not use tandem circuit breakers. Circuit breakers shall have a minimum temperature rating of 75o C.
- E. Current Limiting Molded Case Circuit Breakers: NEMA AB 1. Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, letthrough current and energy level less than or equal to that permitted for same size Class RK5 fuse. Circuit breakers shall have a minimum temperature rating of 75o C.
- F. Enclosure: NEMA PB 1, Type 1 for interior locations; Type 3R for exterior, wet or damp locations.
- G. Cabinet box: 6 inches deep; width: 20 inches for 240 volt and less panelboards, 24 inches for 480-volt panelboards.

- H. Cabinet Front: Flush or surface cabinet front (as indicated on the Drawings), door-on-door construction with concealed trim clamps, concealed hinge, and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.

2.4 MISCELLANEOUS

- A. Panelboards identified for use as service equipment shall be so labeled.
- B. A full-size ground and neutral bus shall be included in all panels.
- C. Feed-through panels are not permitted.
- D. A typed directory card shall be supplied, mounted on the inside of each door.
- E. Panelboards shall be fully fault current rated. The use of series rated circuit breakers is not acceptable.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards in accordance with NEMA PB 1.1.
- B. Install panelboards plumb. Install recessed panelboards flush with wall finishes. Provide supports in accordance with Section 260190.
- C. Height: 6 ft. to top of panelboard. Install panelboards taller than 6 ft. with bottom no more than 4 inches above floor.
- D. Provide filler plates for unused spaces in panelboards.
- E. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.
- F. Provide engraved plastic nameplates under the provisions of Section 260195.
- G. Provide spare conduits out of each recessed panelboard to a location above accessible ceilings and below accessible floors. Minimum spare conduits: 5 empty 3/4 in. Identify each as SPARE.

3.2 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 260010.
- B. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 10 percent of each other. Maintain proper phasing for multiwire branch circuits.
- C. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

END OF SECTION 260470

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SECTION 260480 - THEATRICAL POWER DISTRIBUTION - COMPANY SWITCH

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Theatrical use Company Switches.

1.2 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specifications and other Division 26 Specification Section, apply to this Section.

1.3 REFERENCES

- A. NECA (National Electrical Contractors Association) "Standard of Installation."
- B. NEMA AB 1 Molded Case Circuit Breakers.
- C. NEMA KS 1 Enclosed Switches.
- D. UL 891 – Transfer Switch Equipment.
- E. NFPA 70 National Electrical Code.
- F. NCBCC North Carolina Building Code Council

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. Underwriters Laboratories, Inc.
 - a. UL 891 Listed – Transfer Switch Equipment

1.3 SUBMITTALS

- A. Shop Drawings
 - 1. Product dimensions with front and side elevation views.
 - 2. Support Point Dimensions
 - 3. Connection details and cable entry locations.
 - 4. Interlock wiring diagrams
- B. Product data:
 - 1. Enclosure rating.
 - 2. Assembly ratings including amperage, voltage, number of poles and current interruption rating.

3. Circuit breaker trip curve.
4. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and use of product.

1.4 OPERATION AND MAINTENANCE DATA

- A. Maintenance Data: Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.5 QUALIFICATIONS

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

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by third party agencies accredited by the NCBCC to label electrical and mechanical equipment, as suitable for purpose specified and indicated, where such listing exists.

1.7 WARRANTY

- A. Factory Warranty
 1. Company Switches shall be covered by a manufacturer's warranty for a period of one (1) year from date of shipment from the manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements the following manufacturers are acceptable:
 1. LEX Products Corporation
 2. ESL Power Systems
 3. Hubbell

2.2 COMPANY SWITCHES

A. CONSTRUCTION

1. Enclosure shall be NEMA Type 3R for exterior use and NEMA Type 12 for interior use.
 - a. Unit shall be constructed of carbon steel, seamless, continuously welded, and ground smooth.
 - b. Interior company switch shall be black powder coated inside and out. Exterior unit color shall be beige.

- c. The company switch assembly and CAM type female connectors shall be listed by an accredited 3rd party agency and rated at 400 amps at 240VAC. CAM type female connectors shall be color coded to visualize appropriate voltages. CAM type female connectors shall be provided for each phase, neutral and ground in the appropriate configuration to support required amperage.
- d. The ground CAM type connectors shall be bonded to the enclosure and a sufficient ground provided for the connection of the facility grounding conductor.
- e. Units shall include phase and ground presence indicator lights protected by fuses.
- f. Unit shall be provided with 100% Rated Thermal Magnetic Circuit Breaker. Circuit breaker handle allows breaker to be re-set without opening enclosure
- g. All units with circuit breakers shall be rated at 65kAIC at 240VAC.
- h. Auto-Shut-Off: Interlock switch to main breaker shuts off power when door opened; prevents making or breaking a connection under load.
- i. All bussing shall be of copper material.
- j. Cam-type and lug connections are housed behind lockable door to prevent exposed live connections. An automatically controlled light enhances visibility when door is opened.
- k. The detachable combination Cam-type outlet and the direct wire lug are combined in a compact and convenient arrangement.
- l. Cable entry holes are smooth to protect inserted cables from damage.
- m. Cam-type and lug connections are behind the lockable access door to prevent accidental disconnection, unauthorized access and/or tampering with connections.
- n. The access door to the Cam-type and lug connections is interlocked to the main breaker, which can only be turned on when the access door is closed.
- o. Power shuts off automatically when the access door is opened, eliminating the ability to make or break a connection under load.
- p. Circuit breaker rated at 65,000 AIC (Amps Interrupting Capacity) to exceed requirements for installed dimmers
- q. Integral 100% rated electronic trip circuit breaker enabling continuous operation at maximum capacity
- r. Arrangement of Cam-type and lug terminations enables both sets of cable to drape downward for lower profile when mounted against a wall
- s. Circuit breakers and connection chamber housed behind gasketed door
- t. Circuit breaker door allows for lockout/tagout and restricted access as needed
- u. The chassis ground can be isolated from the main ground for sensitive audio applications.
- v. A strain relief secures cable connections and prevents cables from being pulled out of the connection lugs.

B. ENCLOSURE

- 1. Mount: Wall Mount
- 2. Material: Code gauge sheet metal
- 3. NEMA Type 3R/12
- 4. Finish: Black Power Coat for interior, beige for exterior.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Procedures for Installation

1. Company Switch shall be installed per manuf. requirements and as shown on the drawings.
2. Meet the requirements of local codes, the National Electrical Code and National Electrical Contractors Association's "Standard of Installation." To the satisfaction of the AHJ.
3. Only use copper wire conductors for all field wiring.
4. All terminations must be torqued according to the label provided.

3.2 FIELD TESTING:

A. Prior to energizing company switch, the Contractor shall perform the following checks and tests as a minimum:

1. Verify mounting and connections are complete and secure.
2. Verify internal components and wiring are secure.
3. Perform continuity check of all circuits.
4. Perform 1,000 VDC megger test on feeder, load and ground cables.
5. Verify deadfront is secure.
6. With the company switch deadfront in place and the main access door closed and properly latched, actuate the Operator Mechanism and verify that the circuit breaker can be turned "ON" and "OFF" and can be reset.
7. Confirm operation of the company switch ground receptacle by attaching a plug to the company switch ground receptacle and then verify that the plug is grounded to the facility ground.
8. Once utility power has been applied, confirm operation of the company switch by attaching the proper plugs to each of the company switch phase receptacles and verifying that the correct voltage is present once the circuit breaker is energized.

SECTION 260496 - ENCLOSED TRANSFER SWITCH

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Manual load-transfer switch.

1.2 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specifications and other Division 26 Specification Section, apply to this Section.
- B. Section 26 08 00 - Commissioning of Electrical

1.3 REFERENCES

- A. NFPA 70 - National Electrical Code.
- B. NEMA ICS 1 - General Standards for Industrial Control and Systems.
- C. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers, and Assemblies.
- D. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.
- E. UL 98, Standard for Enclosed and Dead Front Switches.
- F. NEMA Standards Publication KS1-2001 Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)

1.4 SUBMITTALS

- A. Submit under provisions of Section 260010.
- B. Product Data: Provide catalog sheets showing voltage, switch size, ratings and size of switching and overcurrent protective devices, operating logic, short circuit ratings, dimensions, and enclosure details.
- C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.5 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 26 00 10.
- B. Operation Data: Include instructions for operating equipment.
- C. Maintenance Data: Include routine preventative maintenance and lubrication schedule. List special tools, maintenance materials, and replacement parts.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience, and with service facilities within 100 miles of Project.
- B. Supplier: Authorized distributor of specified manufacturer with minimum five years documented experience.

1.7 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by third party agencies accredited by the NCBCC to label electrical and mechanical equipment as suitable for purpose specified and shown, where such listing exists.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 260010.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to internal components, enclosure and finish.

1.9 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on the shop drawings or as instructed by manufacturer.

1.10 MAINTENANCE SERVICE

- A. Furnish service and maintenance of transfer switch for one year from Date of Substantial Completion.

1.11 MAINTENANCE MATERIALS

- A. Provide maintenance materials under provisions of Section 260010.
- B. Provide two of each special tool required for maintenance.

1.12 WARRANTY

- A. The transfer switch and associated equipment shall be warranted by the manufacturer for a period of one (1) year, from the date of final inspection and acceptance. The warranty shall be included in the contract document. The warranty shall include all parts, labor (including travel), expenses and equipment necessary to perform replacement and/or repairs.

PART 2 - PRODUCTS

2.1 DOUBLE-THROW MANUAL LOAD TRANSFER SWITCH

- A. Description: Dead-Front double-throw safety switch manufactured to NEMA standards publication KS1 and listed to UL standard 98.
- B. Configuration: Non-fused, 3-pole transfer with isolated neutral and bonded ground double-barrel lugs.
- C. Features:
 - 1. Spring tension designed double throw switch provides easy operation and snap action of contacts, switching loads with minimum interruption.
 - 2. Non-teasable, quick-make quick-break design minimizes contact arcing and prolongs contact life.
 - 3. Snap action and floating contacts provide positive and complete self-cleaning contact, preventing excessive contact heating.
 - 4. Rugged construction of all mechanical parts.
 - 5. Designed for wall mounting.
 - 6. Oversized enclosure for ample wiring space
 - 7. Three pole configuration with isolated neutral and bonded grounding.

2.2 RATINGS

- A. Voltage: 250 volts, three phase, four wire, 60Hz.
- B. Switched Poles: 3.
- C. Load Inrush Rating: Combination load.
- D. Continuous Rating: Per single line diagram.
- E. Interrupting Capacity: 1000 percent of continuous rating.
- F. Withstand Current Rating: 35,000 RMS symmetrical amperes.

2.3 PRODUCT OPTIONS AND FEATURES

- A. The transfer switch shall be rigidly constructed to close into and withstand the bolted fault current available at the switch.

2.4 ENCLOSURE

- A. Enclosure: NEMA ICS 6, Type 12.
- B. Finish: Manufacturer's standard gray enamel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify conditions under the provisions of Section 260010.
- B. Verify that surface is suitable for transfer switch installation. Provide structural supports.

3.2 INSTALLATION

- A. Install transfer switches in accordance with manufacturer's instructions.
- B. Provide engraved plastic nameplates under the provisions of Section 26 01 95.

END OF SECTION

SECTION 260510 - LUMINAIRES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Interior and building-mounted exterior luminaries.
- B. Emergency lighting units.
- C. Exit signs.
- D. LED drivers
- E. LED lamps and luminaires
- F. Luminaire accessories.

1.2 RELATED SECTIONS

- A. Section 26 01 30 Boxes.
- B. Section 26 08 00 - Commissioning of Electrical

1.3 REFERENCES

A.	NCSCO	EELGD 3/2016	Energy Efficient Lighting Guidance Document for New Construction and Retrofits issued by The State of North Carolina
B.	NFPA	70	National Electrical Code (NEC)
C.	NFPA	101	Life Safety Code
D.	NCSEC	Energy Conservation Code	NC Energy Conservation Code
E.	NCSBC	Building Code	NC State Building Code
F.	IES	LM-79-08	Electrical and Photometric Measurements of Solid State Lighting Products
G.	IES	LM-80	Measuring Lumen Maintenance of LED Light Sources
H.	IES	LM-82	Method for the Characterization of LED Light Engines and Integrated LED Lamps for Electrical and Photometric Properties as a Function of Temperature
I.	IES	LM-84	Measuring Luminous Flux and Color Maintenance of LED Lamps, Light Engines, and Luminaires
J.	IES	RP-16	Nomenclature and Definitions for Illuminating Engineering
K.	IES	TM-21	Projecting Long Term Lumen Maintenance of LED Sources
L.	IES	TM-28	Projecting Long-Term Luminous Flux Maintenance of LED Lamps and Luminaires
M.	IES	TM-30	IES Method for Evaluating Light Source Color Rendition

N.	NEMA	LSD 45	Recommendations for Solid State Lighting Sub Assembly Interfaces for Luminaires
O.	NEMA	SSL 7A	Phase Cut Dimming for Solid State Lighting: Basic Compatibility
P.	NEMA	410	Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts
Q.	NEMA	WD 6	Wiring Devices Dimensional Requirements
R.	ANSI/NEMA/ANSLG	C78.377-	Specifications for the Chromaticity of Solid-State Lighting Products
S.	ANSI/ANSLG	C82.16 (anticipated)	Light Emitting Diode Drivers—Methods of Measurement
T.	ANSI	C82.15 (anticipated)	Robustness Testing for LED Drivers (need official title)
U.	ANSI	C82.77-10	Harmonic Emission Limits—Related Power Quality Requirements for Lighting Equipment
V.	ANSI/IEEE	C62.41.1	IEEE Guide on the Surge Environment in Low-Voltage (1,000 V and Less) AC Power Circuits
W.	ANSI/IEEE	C62.41.2 IEEE	Recommended Practice on Characterization of Surges in Low-Voltage (1,000V and Less) AC Power Circuits
X.	ANSI/UL	1310	Standard for Safety of Class 2 Power Units
Y.	ANSI/UL	1598	Standard for Safety of Luminaires
Z.	ANSI/UL	1598C	Light-Emitting Diode (LED) Retrofit Luminaire Conversion Kits
AA.	ANSI/UL	8750	Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products
BB.	ASHRAE	90.1	Energy Standard for Buildings Except for Low-Rise Residential Buildings
CC.	CIE	Pub. No. 13.3	Method of Measuring and Specifying Color Rendering of Light Sources
DD.	CIE	Pub. No. 15	Colorimetry
EE.	FCC	CFR Title 47 Part 15	Radio Frequency Devices
FF.	IEC	62301 ED.2.0 B:2011	Household electrical appliances—Measurement of standby power
GG.	IEC	62321 Ed. 1.0	Electrotechnical Products—Determination Of Levels Of Six Regulated Substances (lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls, polybrominated diphenyl ethers)
HH.	IEEE	PAR1789	IEEE Recommending Practices for Modulating Current in High Brightness LEDs for Mitigating Health Risks to Viewers

1.4 SUBMITTALS

- A. Submit under provisions of Section 26 00 10.
- B. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.

- C. Product Data: Provide wiring diagram, dimensions, ratings, construction and performance data, including optical efficiency and ballast-lamp system efficiency in lumens per watt and compliance statement for surge protection.
- D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.
- E. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 26 00 10.

Accurately record actual locations of each luminaire.

1.6 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 26 00 10.
- B. Maintenance Data: Include replacement parts list.

1.7 QUALIFICATIONS

- A. Manufacturer Criteria

Manufacturers shall be firms regularly engaged in the manufacture of lighting fixtures of types and ratings required, who have a service organization in the continental US, and whose products have been satisfactorily used in similar service for not less than 5 years. The manufacture of the fixtures shall comply with the provisions of all applicable code and standards. All fixtures shall be tested before shipping.

1.8 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70, NFPA 101.
- B. Furnish products listed and classified by third party agencies accredited by the NCBCC to label electrical and mechanical equipment, as suitable for purpose specified and shown, where such listing exists.

1.9 EXTRA MATERIALS

- A. Furnish under provisions of Section 26 00 10.
- B. Provide two of each type of ballast and driver.

1.10 WARRANTY

- A. Minimum of five 10 years non-prorated warranty is required with each electronic ballast and LED luminaire including all components.

- B. LED arrays in the product(s) will be considered defective in material or workmanship if a total of 5% or more of the individual light-emitting diodes in the product(s) fail to illuminate during normal operation after installation.

PART 2 - PRODUCTS

2.1 LUMINAIRES

- A. Furnish products as specified in the Lighting Fixture Schedule on plans.
- B. Substitutions: Under provisions of Section 26 00 10.
- C. Install drivers, LED assemblies, and specified accessories at factory.
- D. Flicker shall be 15% or less at full power output and dimming range down to 5%
- E. Each luminaire shall be designed to operate at an average operating temperature of 25°C.
- F. The operating temperature range shall be 0°C to 25°C.
- G. EMI/RFI
 - 1. Luminaires and associated on-board circuitry must meet Class A emission limits referred in Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 Non-Consumer requirements for EMI/RFI Emissions.
- H. Photometric & Colorimetric Performance
 - 1. Photometric
 - a. Minimum initial delivered luminaire lumens
 - 1) Identify each type of fixture and the expected delivered luminaire lumens.
 - b. Minimum Luminaire Efficacy (LE) or Luminaire Efficacy Rating (LER):
 - 1) Energy Star and DLC certified products are a source of potentially acceptable luminous efficacy levels.
 - 2. Colorimetric
 - 1) Correlated Color Temperature (CCT): Acceptable CCTs are 2700K, 3000K, 3500K, 4000/4100K, 4500K and 5000K
 - 2) Acceptable tolerances as provided in ANSI C78.377-2015 (LED)
 - 3) Color Rendering Index (CRI) [Ra] ≥ 80 with a positive R9 value
 - 4) Color shift of no less than $\Delta u'v' < 0.007$ during the warranty period.
- I. Surge protection of LED / SSL luminaires
 - 1. Furnish integral transient and surge protection to comply with ANSI C62.41-2002 Category A surge protection standards up to and including 2.5 kV for interior fixtures.
- J. Thermal management of LED luminaires.

1. The thermal management (of the heat generated by the LEDs) shall be of sufficient capacity to assure proper operation of the luminaire over the expected useful life.
2. The LEDs manufacturer's maximum junction temperature for the expected life shall not be exceeded at the average operating ambient temperature.
3. The LED manufacturer's maximum junction temperature for the catastrophic failure shall not be exceeded at the maximum operating ambient temperature.
4. The driver manufacturer's maximum case temperature shall not be exceeded at the maximum operating temperature. Thermal management shall be passive by design. The use of fans or other mechanical cooling devices shall not be allowed.

2.2 BALLASTS

A. LED Drivers:

1. Listed to UL 8750.
2. Voltage: Match luminaire voltage.
3. Inrush current: Limited to Table 2 "Peak Current Requirements with Pulse Widths not exceeding 2 ms duration" of the NEMA-410-2015 standard.
4. Operation to be at standard rated voltage and ampacity of driver and driven SSL.
5. LED Power Supply/Drive Robustness
 - a. Driver efficiency (at full load):
 - 1) $\geq 85\%$ for drivers capable of ≥ 50 watts
 - 2) $\geq 80\%$ for drivers capable of < 50 watts

LAMPS

- A. Provide lamp type specified for luminaire.
- B. Reflector Lamp Beam Patterns: ANSI C78.379.
- C. LED (SSL) Lamps

1. Product Testing:
 - a. Listed to comply with UL 1598 and UL 8750.
 - b. Tested to IES LM-79 and LM-80.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrate and supporting grids for luminaires.
- B. Examine each luminaire to determine suitability for lamps specified.

3.2 INSTALLATION

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

- B. Install suspended luminaries using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.
- C. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prohibit movement.
- D. Install wall mounted luminaires, emergency lighting units and exit signs at height as indicated on Drawings.
- E. Install accessories furnished with each luminaire.
- F. Connect luminaires, emergency lighting units and exit signs to branch circuit outlets provided under Section 26 01 30.
- G. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- H. Bond products and metal accessories to branch circuit equipment grounding conductor.
- I. Install specified lamps in each luminaire, emergency lighting unit and exit sign.

3.3 FIELD QUALITY CONTROL

- A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.4 ADJUSTING

- A. Adjust Work under provisions of Section 26 00 10.
- B. Aim and adjust luminaires as indicated on Drawings or as directed.
- C. Adjust exit sign directional arrows as indicated.
- D. Re-lamp luminaries that have failed lamps at Substantial Completion.

3.5 CLEANING

- A. Clean Work under provisions of Section 26 00 10.
- B. Clean electrical parts to remove conductive and deleterious materials.
- C. Remove dirt and debris from enclosure.
- D. Clean photometric control surfaces as recommended by manufacturer.
- E. Clean finishes and touch up damage.

3.6 DEMONSTRATION

- A. Provide systems demonstration under provisions of Section 26 00 10.

B. Provide demonstration of luminaire operation.

END OF SECTION 26 05 10

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SECTION 260548 - SEISMIC Restraints

PART 1 - GENERAL

1.1 Related Documents and Related Work Specified Elsewhere

A. Related Documents

1. Drawings, Standard General Conditions of the Construction Contract, including Supplementary General Conditions, Division-01 Specification sections and other Division 26, 27, 28 and Division 31 specifications apply to work of this section.

B. The scope of work includes the work required in the following sections.

1.2 QUALITY ASSURANCE

A. Codes and standards: Provide seismic restraint in accordance with the North Carolina Building Code.

PART 2 - PRODUCTS: N/A

PART 3 - EXECUTION

3.1 INSTALLATION

A. The Contractor shall be responsible for providing restraints to resist the earthquake effects on the electrical systems where required. The requirements for these restraints are found in Chapter 16, Section 1613 of the 2018 North Carolina Building Code.

B. For this project:

1. County: New Hanover
2. Risk Category: II
3. Seismic Design Category: C

C. Nonstructural component anchorage: Mechanical and Electrical Components with an importance factor of 1.0 in Seismic Design Categories A, B, or C are exempt from the Seismic Design requirements as specified in NCSBC with reference to ASCE 7.

END OF SECTION 260548

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SECTION 260549 - CONCRETE PADS FOR ELECTRICAL EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections and other Division 26 Specification Sections apply to this section.
- B. All work shall be in accordance with the North Carolina State Building Code – 2018.

PART 2 - SECTION SCOPE

2.1 DESCRIPTION

- A. Material and installation requirements for equipment concrete pads.
- B. House Keeping Pads:
 - 1. 3000# minimum concrete, formed to extend 2” beyond the equipment footprint and finished to a beveled edge, cured for minimum of 1 week prior to loading.
- C. Utility Transformer Pads:
 - 1. Per Utility Company’s published design.
 - 2. Coordinate transformer and pad size with utility company.

END OF SECTION 260549

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SECTION 260800 - COMMISSIONING OF ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Systems and equipment Start-Up and Functional Performance Testing
- B. Validation of proper and thorough installation of Division 23 systems and equipment
- C. Generic Start-Up Documentation for mechanical systems and equipment
- D. Development of final Start-Up Documentation for mechanical systems and equipment
- E. System Start-Up and Turn-Over procedures
- F. Coordination and execution of Training Events

1.2 GENERAL DESCRIPTION

- A. Commissioning (Cx) is the process of ensuring that (i) all building systems are installed and perform interactively according to the design intent; (ii) that systems are efficient and cost effective and meet the Owner's operational needs; (iii) that the installation is accurately documented; and (iv) that the Operators are adequately trained. Commissioning serves as a tool to minimize post-occupancy operational problems, and establishes testing and communication protocols to advance the building systems from installation to optimized, fully-dynamic operation.
- B. Commissioning Agent (CxA) shall work with the Contractor and the contracting officer to direct and oversee the Cx process and perform Functional Performance Testing.
- C. The Commissioning Plan outlines the Cx process beyond the Construction Contract, including design phase activities and design team/owner responsibilities. The specification Sections dictate all requirements of the commissioning process relative to the construction contract. The Cx Plan is not part a construction contract document, although it is available for reference at the request of the Contractor.
- D. This Section outlines the Cx procedures specific to the Division 26, 27 and 28 Contractors. Requirements common to all Sections are specified in Section 01 90 00 and Section 01 90 10 This Section and other sections of the specification details the Contractor's responsibilities relative to the Cx process.

1.3 SCOPE

- A. The following systems and equipment are included in the Scope of Commissioning for this project:
- B. Electrical Systems: All Division 26, 27 and 28 equipment and systems will be subject to commissioning, including but not limited to the systems listed below. All components and devices that make up these systems are included.

1. Lighting Control Systems
2. Electrical Metering System
3. Photovoltaic Systems
4. Telecommunications System
5. Public Address System
6. Intrusion Detection System
7. Fire Alarm System

1.4 RELATED WORK AND DOCUMENTS

- A. The Cx process references many related Sections, particularly Section 01 90 00 - General Commissioning Requirements. It is important for all Contractors subject to the Cx process to be familiar with Section 01 90 00.
- B. Refer to Section 01 90 00 for a complete list of Sections on Related Work.

1.5 DEFINITIONS AND APPRVIATIONS

- A. Refer to Section 01 90 00 for a complete list of Reference Standards

1.6 REFERENCE STANDARDS

- A. National Electric Code (NEC)
- B. American Society for Testing and Materials (ASTM)
- C. Electronics Industry Association/Telecommunications Industry Association (EIA/TIA)
- D. Illuminating Engineering Society (IES)
- E. Institute of Electrical and Electronics Engineers (IEEE)
- F. International Electrical Testing Association (NETA)
- G. National Electrical Manufacturers Associates (NEMA)
- H. National Fire Protection Association (NFPA)
- I. Underwriters Laboratory, Inc. (UL)
- J. Refer to Section 01 90 00 for additional Reference Standards.

1.7 DOCUMENTATION

- A. Documentation shall be as required in Section 01 90 00. In addition, Contractor shall also provide to the CxA the following per the procedures specified herein, in the Cx Plan, and in other Sections of the specification.

1.8 SEQUENCE AND SCHEDULING

- A. Refer to Section 01 90 00.

1.9 COORDINATION MANAGEMENT PROTOCOLS

- A. Coordination responsibilities and management protocols relative to Cx are initially defined in Section 01 90 00 and the Cx Plan, but shall be refined and documented in the Construction Phase Cx Kick-Off Meeting. Contractor shall have input into the protocols to be used and all Parties will commit to scheduling obligations. The CxA will record and distribute.

1.10 CONTRACTOR RESPONSIBILITIES

- A. Refer to Section 01 90 00: Detailed Contractor responsibilities common to all Divisions are specified in Section 01 90 00. The following are additional responsibilities or notable responsibilities specific to Division 23.
- B. Construction Phase
 - 1. Provide skilled technicians qualified to perform the work required.
 - 2. Provide factory-trained and authorized technicians where required by the Contract Documents.
 - 3. Prepare and submit required draft Start-Up Documentation and submit along with the manufacturer's application, installation and start-up information.
 - 4. Provide assistance to the CxA in preparation of the specific Functional Performance Test (FPT) procedures. Contractors, subcontractors and vendors shall review FPT procedures to ensure feasibility, safety and equipment protection and provide necessary written test limits to be used during the tests. Damage caused to equipment performed in accordance with the approved procedures will be the responsibility of the Contractor.
 - 5. Thoroughly complete and inspect installation of systems and equipment as detailed throughout Contract Documents, as required by reference or industry standards, and as specifically indicated elsewhere this Section.
 - 6. Start-Up, test/adjust systems, balance phases at panels, and Turn-Over systems and equipment prior to functional performance testing by the CxA. Approved Start-Up Documentation shall be in accordance with Contract Documents, reference or industry standards, and specifically elsewhere in Part I of this Section.
 - 7. Record Start-Up on approved Start-Up Documentation forms and certify that the systems and equipment have been started and or tested in accordance with the requirements specified above and in Section 01 09 00. Each task or item shall be indicated with the Party actually performing the task or procedure.
 - 8. Coordinate the work of the Electrical Testing Agency and the Cx requirements.
- C. Acceptance Phase
 - 1. Assist CxA in Functional Performance Testing. Assistance will typically include the following:
 - a. Manipulate systems and equipment to facilitate Functional Performance Testing (as specified in Section 01 90 00, Section 01 90 10, and the Cx Plan; in some cases this will entail only an initial sample);
 - b. Provide any specialized instrumentation necessary for Functional Performance Testing;

1.11 EQUIPMENT SUPPLIER RESPONSIBILITIES

- A. Refer to Section 01 90 00.

1.12 CONTRACTOR NOTIFICATION AND SCHEDULING

- A. Refer to Section 01 90 00.

1.13 START-UP DOCUMENTATION

- A. Refer to Section 01 90 00.

1.14 EQUIPMENT NAMEPLATE DATA

- A. Refer to Section 01 90 00.

1.15 SYSTEMS MANUAL AND O&M DOCUMENTATION CONTENT - PREPARATION AND LOGISTICS

- A. Refer to Section 01 90 00 and the individual Specifications.

1.16 FUNCTIONAL PERFORMANCE TESTING

- A. Contractor shall participate in the initial samples of Functional Performance Testing as stipulated in Section 01 90 00 and Section 01 90 10.

1.17 FPT ACCEPTANCE CRITERIA

- A. Acceptance criteria for tests are indicated in Section 01 90 10 and in the specification Sections applicable to the systems being tested. Unless indicated otherwise, the criteria for acceptance will typically be that specified with the individual system, equipment, component, or device.

PART 2 - PRODUCTS

2.1 INSTRUMENTATION

- A. General: All testing equipment used by any Party shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified. Unless otherwise noted, all equipment shall be calibrated according to the manufacturer's recommended intervals. Calibration tags shall be affixed or certificates readily available.
- B. Testing Instrumentation: Contractor shall provide all instrumentation necessary for tests for which they are responsible. CxA will provide standard instrumentation for measuring medium and low voltage electrical voltage, current, power factor, power, and total harmonic distortion (THD). CxA will provide receptacle testers for normal and GFI receptacle tests. Contractor shall provide all other instrumentation required to accomplish the specified testing.

PART 3 - EXECUTION

3.1 GENERIC START-UP DOCUMENTATION -GENERAL

- A. Part III of this Section outlines 'generic' or minimally acceptable Start-Up Documentation (which are defined to include both 'Start-Up Checks' and 'Start-Up Tests') and individual systems training requirements for systems and equipment. These procedures are the direct responsibility of the Contractor as a basic element of validating that the installation is correct per normal quality control practices. These items shall provide a minimally acceptable guideline for required Contractor development of Start-Up Documentation. Contractor shall synthesize these minimum requirements along with their own internal quality control practices, those of the manufacturer, and any applicable codes and standards to develop specific and itemized final Start-Up Documentation specific to the equipment and systems installed on this project.
- B. Section 01 90 00 defines the systems and equipment Start-Up process in detail and provides definitions for Start-Up Documentation, including the generic Start-Up Documentation provided below.
- C. The Division 26 technical sections define the required electrical testing.

3.2 TESTING PROCEDURES

- A. Grounding Systems
 - 1. Perform three-point fall-of-potential test per IEEE Standard 81 on the main grounding electrode or system. Resistance shall be no greater than 25 ohms.
 - 2. Perform the two-point method test per IEEE Standard 81 to determine the ground resistance between the main ground system and all major electrical equipment frames,

3.3 START-UP DOCUMENTATION COMMON TO ALL SYSTEMS

- A. The following Start-Up verifications and procedures shall be considered common to all systems:
 - 1. Checkout shall proceed from lower level devices to larger components to the entire system operation.
 - 2. Verify labeling is affixed per specification and visible.
 - 3. Verify prerequisite procedures are done.
 - 4. Inspect for damage and ensure none is present.
 - 5. Verify system is installed per the manufacturer's recommendations.
 - 6. Verify system has undergone Start-Up per the manufacturer's recommendations.
 - 7. Verify that dedicated electrical space and electrical workspace clearances are met.
 - 8. Verify that access is provided for inspection, operation and repair.
 - 9. Verify that access is provided for eventual replacement of the equipment.
 - 10. Verify that record drawings, submittal data and O&M documentation accurately reflect the installed systems.
 - 11. Verify all interfaces are provided as required by contract documents and manufacturer's recommendations.
 - 12. Verify all recorded nameplate data is accurate.
 - 13. Verify that the installation ensures safe operation and maintenance.
 - 14. Verify specified stock replacement material has been provided as required by the Contract Documents.

15. Verify all monitoring and ensure all alarms are active and set per Owner's requirements.
16. Complete all nameplate data and confirm that ratings conform to the design documents.

END OF SECTION 260800

SECTION 260943 - NETWORK LIGHTING CONTROLS

PART 1 - GENERAL

1.1 Summary

- A. The lighting control system specified in this section shall be capable to provide time-based, sensor-based (both occupancy and daylight), and manual lighting control for normal power operation. Under power loss operation the switch states remain and power to the combination normal/emergency light fixtures is maintained via emergency power shunt devices. The emergency power shunt devices control the dimming status to 100% output for the duration of the normal power loss.
- B. The system shall be capable of turning lighting loads on/off as well as dimming lights (if lighting load is designated to be dimmed.)
- C. All system devices and equipment shall be networked together enabling digital communication and shall be individually addressable.
- D. Where compatible, addressable light fixture types with integral controls and/or integral power packs are used, the controls components shall also be individually addressable.
- E. The system architecture shall be programmed for stand-alone groups (rooms) of devices to function in some default capacity even if network connectivity to the greater system is lost.
- F. The system architecture shall facilitate remote operation via a computer connection.
- G. The system shall not require any centrally hardwired switching equipment.
- H. The system shall be capable of wireless, wired, or hybrid wireless/wired architectures.

1.2 Related Sections

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specifications and other Division 26 Specification Section, apply to this Section.
- B. 26 08 00 - Commissioning of Electrical. The term CxA refers to the owner's commissioning agent.

1.3 Project Conditions

- A. Only install equipment after the following site conditions are maintained:
 - 1. Ambient Temperature 14 to 105 degrees F (-10 to 40 degrees C)
 - 2. Relative Humidity less than 90% non-condensing
 - 3. Standard electrical enclosures are permanently installed
 - 4. Equipment is protected from dust, debris and moisture.

- B. All Class1 and Class 2 wiring shall be concealed. All Class 1 wiring shall be in raceway. All Class2 wiring may be in dedicated J-hooks above suspended ceilings and in unfinished areas, but in conduit concealed in walls stubbed to above suspended ceilings and in finished areas accessible to the public. Use extended chase nipples for conduit terminations at power packs and emergency shunt trip relays not integrated with light fixtures. Keep separation of emergency and normal power circuits per NEC section 700.
- C. Refer to Light Fixture Schedule for integrated lighting controls options. Provide external controls for substitute light fixtures without integral controls.

1.4 Submittals

- A. Submit under provisions of Section 26 00 10.
- B. Submit lighting controls submittal together with the light fixture submittals under section 26 05 10.
- C. Product Datasheets (general device descriptions, dimensions, wiring details, nomenclature)
- D. Riser Diagrams – typical per room type (detailed drawings showing device interconnectivity of devices)
- E. Other Diagrams – as needed for special operation or interaction with other system(s)
- F. Example Contractor Startup/Commissioning Worksheet – must be completed prior to factory start-up
- G. BACNet IP address mapping spreadsheet.

1.5 Quality Assurance

- A. All components and the manufacturing facility where product was manufactured must be ROHS compliant.
- B. In high humidity or cold environments, the sensors shall be conformably coated and rated for condensing humidity and -40 degree Fahrenheit (and Celsius) operation.
- C. All applicable products must be listed by an NRTL acceptable to the NCBCC.

1.6 Coordination

- A. Coordinate integration of lighting control components with other systems with CxA.
 - 1. BacNet IP and hardwired contact closure. Provide fail-safe interconnection with fire alarm system. Interface components shall not be more than 3'-0" apart and labeled for the purpose. Safe state is 100% light level throughout.
 - 2. The installing contractor shall be responsible for a complete and functional system in accordance with all applicable local and national codes.

1.7 Warranty

- A. All devices in lighting control system shall have a 5 year warranty.

PART 2 - PRODUCTS

2.1 Manufacturers

Subject to requirements the following manufacturers are acceptable:

- A. Acuity
- B. Lutron
- C. ETC

2.2 System Requirements

- A. System shall have an architecture that is based upon three main concepts; 1) intelligent lighting control devices 2) standalone lighting control zones 3) network backbone for remote and time based operation.
- B. During normal power loss transfer emergency light fixtures from normal power to emergency power sources for a continuous full 100% light output during power outages. Re-transfer power to normal sources with return of normal power and restore switch and dimming status to pre – power outage status. Emergency power transfer devices shall be listed in accordance with UL 924.
- C. Provide network backbone equipment for scheduling and systems interfaces in this project.
- D. Interfaces with building systems: (Coordinate all interfaces with CxA.)
 - 1. Fire Alarm: Upon de-activation of fire alarm relay and opening of normally open contact provide 100% light levels throughout public spaces. Provide reset with re-activation of fire alarm relay.
 - 2. BacNet Interface: Provide BACNet interface and address map for % dimming, on/off lighting status, occupancy and daylight status via BACNet IP to CxA. Accept eight coded high-level remote lighting control input commands via remote BACNet IP input including business hour status on / off and Light level maximum / off / normal.
- E. Intelligent lighting control devices shall consist of one or more basic lighting control components; occupancy sensors, photocell sensors, relays, dimming outputs, manual switch stations, manual dimming stations and touchscreen type multifunctional human-machine interface (HMI). Combining one or more of these components into a single device enclosure should be pursued so as to minimize overall device count of system.
- F. The lighting control system shall be compatible with the selected light fixtures and their controls interface for 0-10V continuous dimming and step dimming as indicated on plans.
- G. Intelligent lighting control devices shall communicate digitally, require <4 mA of current to function (Graphic wall stations excluded), and include RJ-45 style connectors.
- H. Lighting control zones shall consist of one or more intelligent lighting control components, be capable of stand-alone operation, and be capable of being connected to a higher level network backbone.

- I. Devices within a lighting control zone shall be connected with CAT-5e low voltage cabling in any order.
 - J. Lighting control zone shall be capable of automatically configuring itself for default operation without any start-up labor required.
 - K. Individual lighting zones must continue to provide a user defined default level of lighting control in the event of a system communication failure with the backbone network or the management software becoming unavailable.
 - L. Power for devices within a lighting control zone shall come from either resident devices already present for switching (relay device) or dimming purposes, or from the network backbone. Standalone "bus power supplies" shall not be required in all cases.
 - M. All switching and dimming for a specific lighting zone shall take place within the devices located in the zone itself (i.e. not in a remotely located devices such as panels) to facilitate system robustness and minimize wiring requirements. Specific applications that require centralized or remote switching shall be capable of being accommodated.
 - N. System shall have one or more primary wall mounted network control "gateway" devices that are capable of accessing and controlling connected system devices and linking into an Ethernet LAN only where it would be required for stand-alone operation of the lighting zones.
 - O. System shall use "bridge" devices that route communication and distribute power for up to 8 directly connected lighting zones together for purposes of decreasing system wiring requirements only where it would be required for stand-alone operation of the lighting zones.
 - P. Systems and networking devices such as gateways and bridges shall be located in a continuous hinge finished enclosure 'LC' sized to accommodate networking devices and touchscreen system access control recessed into door. Enclosure shall be industrial grade WxHxD min. 20"x20"x6" manufactured from min. 14 gauge steel, primed and painted in light color w/ network interface touchscreen device semi-recessed into front and power packs fed via adjacent electrical box. Power packs shall be installed through a sidewall with their chase nipples entering an adjacent electrical box for termination. A data outlet shall be recessed in the cabinet's sidewall with an Ethernet patch cable connecting to the building LAN network. Provide single channel data jack.
 - Q. System shall include a web-based software management program that enables remote system control, status monitoring, and creation of lighting control profiles including all licenses and lifetime upgrade service for permanent access to the system.
 - R. Individual lighting zones shall be capable of being segmented into several "local" channels of occupancy, photocell, and switch functionality for more advanced configurations and sequences of operation.
 - S. Devices located in different lighting zones shall be able to communicate occupancy, photocell, and switch information via either the wired backbone.
1. Required system operations are indicated per-space on Sheet E-102 of the drawings.

2. System shall be capable of operating a lighting control zone according to several sequences of operation. System shall be capable to change a spaces sequence of operation according to a time schedule so as to enable customized time-of-day, day-of-week utilization of a space. Note operating modes should be utilized only in manners consistent with local energy codes.
 - a. Auto-On / Auto-Off (via occupancy sensors)
 - 1) Zones with occupancy sensors automatically turn lights on when occupant is detected.
 - 2) Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
 - 3) Pressing a switch will turn lights off. The lights will remain off regardless of occupancy until switch is pressed again, restoring the sensor to Automatic On functionality.
 - b. Manual-On / Auto-Off (also called Semi-Automatic)
 - 1) Pushing a switch will turn lights on.
 - 2) Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
 - 3) Pushing a switch will turn lights on.
 - 4) After initial lights on, zones with occupancy and/or photocell sensors turn lights on/off according to occupancy/vacancy and/or daylight conditions.
 - c. Manual-On to Auto-On/Auto-Off
 - 1) Sequence can be reset via scheduled (ex. daily each morning) events
 - d. Auto-to-Override On
 - 1) Zones with occupancy sensors automatically turn lights on when occupant is detected.
 - 2) Zone lighting then goes into an override on state for a set amount of time or until the next time event returns the lighting to an auto-off style of control.
 - 3) Sequence can be reset via scheduled (ex. daily each morning) events
 - e. Manual-to-Override On
 - 1) Pushing a switch will turn lights on.
 - 2) Zone lighting then goes into an override on state for a set amount of time or until the next time event returns the lighting to an auto-off style of control.
 - 3) Sequence can be reset via scheduled (ex. daily each morning) events
 - f. Auto On / Predictive Off
 - 1) Zones with occupancy sensors automatically turn lights on when occupant is detected.
 - 2) Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
 - 3) If switch is pressed, lights turn off and a short “exit timer” begins. After timer expires, sensor scans the room to detect whether occupant is still present. If no

occupancy is detected, zone returns to auto-on. If occupancy is detected, lights must be turned on via the switch.

g. Multi-Level Operation (multiple lighting levels per manual button press)

- 1) Operating mode designed specifically for bi-level applications
- 2) Enables the user to cycle through the up to four potential on/off lighting states using only a single button.
- 3) Eliminates user confusion as to which of two buttons controls which load
- 4) Three different transition sequences are available in order to comply with energy codes or user preference)
- 5) Depending on the sequence selected, every button push steps through relays states according to below table.

	Alternating Sequence		Full On Sequence		3 Step On Sequence	
Sequence State #	Relay 1	Relay 2	Relay 1	Relay 2	Relay 1	Relay 2
1	On	Off	On	Off	On	Off
2	Off	On	-	-	Off	On
3	-	-	On	On	On	On
4*	Off	Off	Off	Off	Off	Off

(*step only present for devices without separate off button)

- h. In addition to achieving bi-level lighting control by switching loads with relays, the ability to command dimming outputs to “step” in a sequence that achieves bi-level operation is present.
- i. A taskbar style desktop application shall be available for personal lighting control.
- j. An application that runs on “smart” handheld devices (such as an Apple® iPhone®) shall be available for personal lighting control.
- k. Control software shall enable logging of system performance data and presenting useful information in a web-based graphical format and downloadable to .CSV files.
- l. Control software shall enable integration with a BMS via BACNet IP.
- m. System shall use factory pre-terminated plenum rated CAT-5 low voltage signal cables or field-terminated CAT-5 cables. All terminations shall be labeled, supervised and

documented by a NICET certified technician. Unsupervised and un-documented controls wiring will be discarded and re-done at no additional cost to the owner.

2.3 Individual Device Specifications

- A. Control Module (Gateway) (Only where it would be required for stand-alone operation of the lighting zones.)
 - 1. Control module shall be a device that facilitates communication and time-based control of downstream network devices and linking into an Ethernet.
 - 2. Devices shall have a user interface that is capable of wall mounting, powered by low voltage, and have a touch screen.
 - 3. Control device shall have three RJ-45 ports for connection to other backbone devices (bridges) or directly to lighting control devices.
 - 4. Device shall automatically detect all devices downstream of it.
 - 5. Device shall have a standard and astronomical internal time clock.
 - 6. Device shall have one RJ-45 10/100 BaseT Ethernet connection.
 - 7. Device shall have a USB port
 - 8. Each control gateway device shall be capable of linking 1500 devices to the management software.
 - 9. Device shall be capable of using a dedicated or DHCP assigned IP address.
 - 10. Network Control Gateway device shall be the following Sensor Switch model Series:

2.4 Networked System Occupancy Sensors

- A. Occupancy sensors system shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.
- B. Sensors shall utilize passive infrared (PIR) technology, which detects occupant motion, to initially turn lights on from an off state; thus preventing false on conditions. Ultrasonic or Microwave based sensing technologies shall not be accepted.
- C. For applications where a second method of sensing is necessary to adequately detect maintained occupancy (such as in rooms with obstructions), a sensor with an additional “dual” technology shall be used.
- D. Dual technology sensors shall have one of its two technologies not require motion to detect occupancy. Acceptable dual technology includes PIR/Microphonics (also known as Passive Dual Technology or PDT) which both looks for occupant motion and listens for sounds indicating occupants. Sensors where both technologies detect motion (PIR/Ultrasonic) shall not be acceptable.
- E. All sensing technologies shall be acoustically passive meaning they do not transmit sound waves of any frequency (for example in the Ultrasonic range), as these technologies have the potential for interference with other electronic devices within the space (such as electronic white board readers). Acceptable detection technologies include Passive Infrared (PIR), and/or Microphonics technology. Ultrasonic or Microwave based sensing technologies shall not be accepted.
- F. Sensors shall be available with zero, one, or two integrated Class 1 switching relays, and up to one 0-10 VDC dimming output. Sensors shall be capable of switching 120 / 277 / 347 VAC.

Load ratings shall be 800 W @ 120 VAC, 1200 W @ 277 VAC, 1500 W @ 347 VAC, and ¼ HP motor. Relays shall be dry contacts.

- G. Sensors shall be available with one or two occupancy “poles”, each of which provides a programmable time delay.
- H. Sensors shall be available in multiple lens options which are customized for specific applications.
- I. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
- J. All sensors shall have two RJ-45 ports or capable of utilizing a splitter.
- K. All sensors shall have the ability to detect when it is not receiving valid communication (via CAT-5 connections) and blink its LED in a pattern to visually indicate of a potential wiring issue
- L. Every sensor parameter shall be available and configurable remotely from the software and locally via the device push-button.
- M. Sensors shall be able to function together with other sensors in order to provide expanded coverage areas by simply daisy-chain wiring together the units with CAT-5 cabling.
- N. Sensors shall be equipped with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements.
- O. Wall switch sensors shall recess into single-gang switch box and fit a standard GFI opening.
- P. Wall switch sensors must meet NEC grounding requirements by providing a dedicated ground connection and grounding to mounting strap. Line and load wire connections shall be interchangeable. Sensor shall not allow current to pass to the load when sensor is in the unoccupied (Off) condition.
- Q. Wall switch sensors shall have optional features for photocell/daylight override, vandal resistant lens, and low temperature/high humidity operation.
- R. Wall switch sensors shall be available in four standard colors (Ivory, White, Light Almond, Gray)
- S. Wall switch sensors shall be available with optional raise/lower dimming adjustment controls
- T. Network system shall also have ceiling, fixture, recessed, & corner mounted sensors available.
- U. Sensors shall have optional features for photocell/daylight override, dimming control, and low temperature/high humidity operation.
- V. Sensors with dimming can control 0 to 10 VDC dimmable ballasts and SSL drivers by sinking up to 20 mA of Class 2 current (typically 40 or more ballasts).

2.5 Networked System Power (Relay) Packs

- A. Power Pack shall incorporate one or more Class 1 relays and contribute low voltage power to the rest of the system. Secondary Packs shall incorporate the relay(s), shall have an optional 2nd relay, 0-10 VDC dimming output, or line voltage dimming output, but shall not be required to contribute system power. Power Supplies shall provide system power only, but are not required to switch line voltage circuit. Auxiliary Relay Packs shall switch low voltage circuits only.
- B. Power Packs shall accept 120 or 277 VAC (or optionally 347 VAC), be plenum rated, and provide Class 2 power to the system.
- C. All devices shall have two RJ-45 ports.
- D. Every Power Pack parameter shall be available and configurable remotely from the software and locally via the device push-button.
- E. Power Pack shall securely mount to junction location through a threaded ½ inch chase nipple or be capable of being secured within a luminaire ballast channel. Plastic clips into junction box shall not be accepted. All Class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads. Note: UL Listing under Energy Management or Industrial Control Equipment automatically meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.
- F. When required by local code, Power Pack must install inside standard electrical enclosure and provide UL recognized support to junction box. All Class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.
- G. Power Packs and Power Supplies shall be available that are WiFi enabled.
- H. Power (Secondary) Packs shall be available that provide up to 16 Amp switching of all lighting load types.
- I. Power (Secondary) Packs shall be available that provide up to 5 Amps switching of all lighting load types as well as 0-10 VDC dimming or fluorescent ballasts/LED drivers.
- J. Specific Secondary Packs shall be available that provide up to 5 Amps of switching as well as 0-10 VDC dimming of fluorescent ballasts/LED drivers.
- K. Specific Secondary Packs shall be available that provide up to 5 Amps of switching and can dim 120 VAC incandescent lighting loads or 120/277 VAC line voltage dimmable fluorescent ballasts (2-wire and 3-wire versions).
- L. Specific Secondary Packs shall be available that provide up to 5 Amps of switching and can dim 120/277 VAC magnetic low voltage transformers.
- M. Specific Secondary Packs shall be available that provide up to 4 Amps of switching and can dim 120 VAC electronic low voltage transformers.
- N. Specific Secondary Packs shall be available that provide up to 5 Amps of switching of dual phase (208/240/480 VAC) lighting loads.

- O. Specific Secondary Packs shall be available that require a manual switch signal (via a networked Wall Station) in order to close its relay.
- P. Specific Power/Secondary Packs shall be available that are UL924 listed for switching of Emergency Power circuits.
- Q. Specific Secondary Packs shall be available that control louver/damper motors for skylights.
- R. Specific Secondary Packs shall be available that provide a pulse on/pulse off signal for purposes of controlling shade systems via relay inputs.

2.7 Networked Auxiliary Input/Output (I/O) Devices

- A. Devices shall be plenum rated and be inline wired, screw mountable, or have an extended chase nipple for mounting to a ½" knockout.
- B. Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
- C. I/O devices shall have a dimming control output that can control 0-10 VDC dimmable ballasts or LED drivers by sinking up to 20 mA of current (typically 40 or more ballasts).
- D. I/O devices shall have an input that read a 0-10 VDC signal from an external device.
- E. I/O devices shall have a switch input that can interface with either a maintained or momentary switch and run a switch event, run a local/remote control profile, or raise/lower a dimming output
- F. I/O devices shall sense state of low voltage outdoor photocells
- G. Provide I/O device with RS-232 communication between lighting control system and Audio/Visual (A/V) control systems in Post Production, Classroom under the base bid to remotely control the scenes.
- H. Bid Alternate#1: Provide I/O device with RS-232 communication between lighting control system and Audio/Visual (A/V) control systems in Cinema and Projection Room to remotely control the scenes.

2.8 Networked Led Luminaires

- A. Networked LED luminaire shall have a mechanically integrated control device
- B. Networked LED luminaire shall have two RJ-45 ports
- C. Networked LED luminaire shall be able to digitally network directly to other network control devices (sensors, photocells, switches, dimmers)
- D. Networked LED luminaire shall provide low voltage power to other networked control devices
- E. System shall be able to turn on/off LED luminaire without using a relay

- F. System shall be able to maintain constant lumen output over the specified life of the LED luminarie (also called lumen compensation) by varying the input control power (and thus saving up to 20% power usage).
- G. System shall indicate (via a blink warning) when the LED luminaire has reached its expected life (in hrs).

2.9 Networked System Wall Switches & Dimmers

- A. Devices shall recess into single-gang switch box and fit a standard GFI opening.
- B. Devices shall be available with zero or one integrated Class 1 switching relay.
- C. Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
- D. All sensors shall have two RJ-45 ports.
- E. All devices shall provide toggle switch control. Dimming control and low temperature/high humidity operation are available options.
- F. Devices shall be available in four colors (Ivory, White, Light Almond, and Gray).
- G. Devices with dimming control outputs can control 0-10 VDC dimmable ballasts by sinking up to 20 mA of current (typically 40 or more ballasts).
- H. Provide manual devices with mechanical push-buttons and tactile and LED user feedback.
- I. Devices with mechanical push-buttons shall have buttons factory labeled for unambiguous association with Zones and Scenes. Coordinate labeling with CxA.
- J. Provide clear machine – written labels for each manual control option. Wall switches & dimmers shall be the following Sensor Switch model numbers, with device options as specified:

2.10 Networked System Graphic Wall Station

- A. Graphic Wall Station shall be mounted in the Cinema to initiate password protected presentation scenes.
- B. Graphic Wall Station shall have a 3.5” full color touch screen for selecting up to eight programmable lighting control presets or acting as up to 16 on/off/dim control switches.
- C. Device shall enable configuration of lighting presets, switched, and dimmers via password protected setup screens.
- D. Device shall enable user supplied .jpg screen saver image to be uploaded.
- E. Device shall be surface mount to single-gang switch box
- F. Device shall have a micro-USB style connector for local computer connectivity.
- G. Device shall have two RJ-45 ports for communication

2.11 Networked System Scene Controllers

- A. Device shall have two to four buttons for selecting programmable lighting control profiles or acting as on/off switches.
- B. Device shall recess into single-gang switch box and fit a standard GFI opening.
- C. Devices shall provide LED user feedback.
- D. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
- E. All sensors shall have two RJ-45 ports.
- F. Device shall be capable of reprogramming other devices in its zone so as to implement user selected lighting scene.
- G. Device shall be capable of selecting a lighting profile be run by the system's upstream Gateway so as to implement selected lighting profile across multiple zones (and not just its local zone).
- H. Device shall have LEDs indicating current selection.

2.12 Communication Bridges (Only Where It Would Be Required For Stand-Alone Operation Of The Lighting Zones.)

- A. Device shall surface mount to a standard 4" x 4" square junction box.
- B. Device shall have 8 RJ-45 ports.
- C. Device shall be capable of aggregating communication from multiple lighting control zones for purposes of minimizing backbone wiring requirements back to Control Gateway.
- D. Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply or delivered via a CAT-5 cabled connection.
- E. Device shall be careful of redistributing power from its local supply and connect lighting control zones with excess power to lighting control zones with insufficient local power. This architecture also enables loss of power to a particular area to be less impactful on network lighting control system.

2.13 Lighting Control Profiles

- A. Changes to the operation of the system shall be capable of being made in real-time or scheduled via lighting control profiles. These profiles are outlines of settings that direct how a collection of devices function for a defined time period.
- B. Lighting control profiles shall be capable of being created and applied to a single device, zone of devices, or customized group of zones.
- C. All relays and dimming outputs shall be capable of being scheduled to track or ignore information regarding occupancy, daylight, and local user switches via lighting control profiles.

- D. Every device parameter (e.g. sensor time delay and photocell set-point) shall be configurable via a lighting control profile.
- E. All lighting control profiles shall be stored on the network control gateway device and on the software's host server.
- F. Lighting control profiles shall be capable of being scheduled to run according to the following calendar options: start date/hour/minute, end date/hour/minute, and sunrise/sunset +/- timed offsets.
- G. Sunrise/sunset times shall be automatically derived from location information using an astronomical clock.
- H. Daylight savings time adjustments shall be capable of being performed automatically, if desired.
- I. Lighting control profile schedules shall be capable of being given the following recurrence settings: daily, weekday, weekend, weekly, monthly, and yearly.
 - 1. Software shall provide a graphical tool for easily viewing scheduled lighting control profiles.

2.14 MANAGEMENT SOFTWARE

- A. Management software shall include a single seat lifetime license.
- B. Every device parameter (e.g. sensor time delay and photocell set-point) shall be available and configurable remotely from the software
- C. The following status monitoring information shall be made available from the software for all devices for which it is applicable: current occupancy status, current PIR Status, current Microphonics Status, remaining occupancy time delay(s), current photocell reading, current photocell inhibiting state, photocell transitions time remaining, current dim level, device temperature, and device relay state(s).
- D. The following device identification information shall be made available from the software: model number, model description, serial number, manufacturing date code, custom label(s), and parent network device.
- E. A printable network inventory report shall be available via the software.
- F. A printable report detailing all system profiles shall be available via the software.
- G. Software shall require all users to login with a User Name and Password.
- H. Software shall provide at least three permission levels for users
- I. All sensitive stored information and privileged communication by the software shall be encrypted.
- J. All device firmware and system software updates must be available for automatic download and installation via the internet.

- K. Software shall be capable of managing systems interconnected via a WAN connection.(wide area network)

2.15 Building Management System (BMS) Compatibility

- A. System shall provide a BACNet IP gateway as downloadable software plug-in to its management software. No additional hardware shall be required.
- B. BACNet IP gateway software shall communicate information gathered by networked system to other building management systems.
- C. BACNet IP gateway software shall translate and forward lighting relay and other select control commands from BMS system to networked control devices.

PART 3 - Execution

3.1 Installation

- A. Install equipment and devices level and plumb and according to manufacturer's written instructions.

3.2 Control Wiring Installation

- A. Install wiring between sensing and control devices in raceways and according to manufacturer's written instructions.
- B. Bundle, train, and support wiring in enclosures.
- C. Ground equipment and bond metallic doors.
- D. Connections: Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

3.3 Identification

- A. Identify components and power and control wiring according to Division 26 Section "Electrical Identification."

3.4 Interfaces

- A. Networked Auxiliary Input / Output (I/O) Devices
 1. Devices shall be plenum rated and have an extended chase nipple for mounting to a ½" knockout.
 2. Devices shall have two RJ-45 ports
 3. Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
 4. Specific I/O devices shall have a dimming control output that can control 0-10 VDC dimmable ballasts or LED drivers by sinking up to 20 mA of current.

5. Specific I/O devices shall have an input that reads a 0-10 VDC signal from an external device.
6. Specific I/O devices shall have a switch input that can interface with either a maintained or momentary switch and run a switch event (toggle the lighting load) or run a local/remote control profile.
7. Specific I/O devices shall sense state of low voltage outdoor photocells.
9. Specific I/O devices shall sense momentary and maintained contact closures, and either toggle a connected load after a momentary contact or ramp the load high/low during a maintained contact (stopping when the contact releases).

3.5 Field Quality Control

- A. Schedule visual and mechanical inspections and electrical tests with at least seven days' advance notice.
- B. Inspect control components for defects and physical damage, testing laboratory labeling, and nameplate compliance with the Contract Documents.
- C. Verify settings of photoelectric devices with photometer calibrated within previous six months.
- D. Electrical Tests: Use particular caution when testing devices containing solid-state components. Perform the following according to manufacturer's written instructions:
 1. Continuity tests of circuits.
 2. Operational Tests: Set and operate devices to demonstrate their functions and capabilities in a methodical sequence that cues and reproduces actual operating functions.
 - a. Include testing of devices under conditions that simulate actual operational conditions. Record control settings, operations, cues, and functional observations.
- E. Correct deficiencies, make necessary adjustments, and retest. Verify that specified requirements are met.
- F. Test Labeling: After satisfactory completion of tests and inspections, apply a label to tested components indicating test results, date, and responsible agency and representative.
- G. Reports: Written reports of tests and observations. Record defective materials and workmanship and unsatisfactory test results. Record repairs and adjustments.

3.6 Cleaning

- A. Cleaning: Clean equipment and devices internally and externally using methods and materials recommended by manufacturers, and repair damaged finishes.

3.7 Start-Up & Support Features

- A. To facilitate start-up, all devices daisy-chained together (using CAT-5 cables) shall automatically be grouped together into a functional lighting control zone.
- B. All lighting control zones shall be able to function according to default settings once adequate power is applied and before any system software is installed.

- C. Once software is installed, system shall be able to auto-discover all system devices without requiring any commissioning.
- D. All system devices shall be capable of being given user defined names.
- E. All devices within the network shall be able to have their firmware reprogrammed remotely and without being physically uninstalled for purposes of upgrading functionality at a later date.
- F. All sensor devices shall have the ability to detect improper communication wiring and blink its LED in a specific cadence as to alert installation/startup personnel.

3.8 Owner Training

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:
 - 1. Train Owner's maintenance personnel on operating, troubleshooting, servicing, adjusting, and preventive maintenance. Provide a minimum of six (6) hours' training.
 - 2. Training Aid: Use the approved final version of maintenance manuals as a training aid.
 - 3. Schedule training with Owner, through CxA, with at least (14) days' advance notice.
 - 4. Two copies of a written, bound summary will be provided, for future reference.

3.9 On-Site Assistance

- A. Occupancy Adjustments: Within one year of date of Substantial Completion, provide up to three Project site visits, when requested, to adjust light levels, make program changes, and adjust sensors and controls to suit actual conditions and operational requirements.

3.10 Programming, Testing, And Certification:

- A. Upon completion of the installation and its programming, the lighting controller technician shall test every device and fixture for proper function and document the test results for review by the owner's commissioning agent. Also, in coordination with the other building system contractors, all other system functions shall be verified, including interfaces with the Fire Alarm and A/V systems.
- B. After completion of the 100% system test and submission of documentation per A, the contractor is to request the CxA to set up an inspection. The system shall operate for at least two days prior to this inspection.
- C. The lighting control system will be inspected, with portions of it functionally tested. The contractor shall provide two-way radios, ladders, and other materials needed for testing the system.

3.11 Documentation, Owner Training, And Spare Parts:

- A. The contractor shall provide to the owner and CxA three bound copies AND (4) data DVDs of the following technical information, for transmittal to the owner: (1) As-built floor plans and riser wiring diagrams showing all equipment, devices, line and low voltage circuits, interfaces with other systems, (2) Manufacturer's detailed maintenance requirements, (3) Technical

literature on all control equipment, devices, relays, etc., (4) The as-built "calculations" sheet indicating power consumption and voltage drops.

- B. Complete configuration data (site-specific programming) for the system shall be stored on electronic media and archived by the controls system manufacturer or authorized distributor. Four (4) copies of CD containing this data shall be submitted to the CxA for transmission to the owner on the day the system is commissioned.
- C. The manufacturer, or authorized distributor, shall 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.

END OF SECTION 260943

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SECTION 262713 - ELECTRICAL METERING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Electrical Power Sub-Meter

1.2 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specifications and other Division 26 Specification Section, apply to this Section.
- B. 26 08 00 - Commissioning of Electrical

1.3 REFERENCES

- A. ANSI/NFPA 70 National Electrical Code.
- B. NCBCC: North Carolina Building Code Council
- C. NRTL: Nationally Recognized Testing Laboratory.

1.4 SUBMITTALS

- A. Submit under provisions of Section 26 00 10.
- B. Shop Drawings: Indicate make and model of meters intended for testing and their calibration record, location at switchboard panels and routing of network wiring and barriers to meet NEC and manufacturing standards.
- C. Product Data: Data sheets with salient details of equipment provided.
- D. Manufacturer's Instructions: Indicate application conditions and limitations of use and include instructions for use and interface.

1.5 QUALIFICATIONS

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

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Provide Products listed and classified by a NRTL accredited by the NCBCC to label electrical and mechanical equipment, as suitable for the purpose specified and indicated, where such listing exists.

PART 2 - PRODUCTS

2.1 POWER METERS

- A. The meter shall be NRTL listed and marked.
- B. Power meter shall be designed for Multifunction Electrical Measurement on 3 phase power systems.
 - 1. Meter shall support 3-Element Wye, 2.5 Element Wye, 2 Element Delta, 4 wire Delta systems.
 - 2. Metering shall be 3-Element Wye.
 - 3. Surge withstand shall conform to IEEE C37.90.1 and ANSI C62.41 (6 kV)
 - 4. The meter shall be user programmable for voltage range to any CT or PT ratio.
 - 5. Meter shall have a burden of not more than 0.36VA per phase Max at 600V, 0.014VA at 120 Volts.
 - 6. Meter shall have a burden of not more than 0.005VA per phase Max at 11 Amps.
 - 7. The meter shall accept a voltage input range from 20 up to 576 Volts Line to Neutral, and a range from 0 up to 721 Volts Line to Line.
 - 8. Meter shall accept a current reading of up to 10 Amps continuous. Start up current for a 5 Amp input shall be no greater than 0.005 Amps.
 - 9. Meter shall come standard with one solid state KYZ pulse output for remote energy pulse counting.
- C. Power meter shall allow all wiring through the front of the unit, so that the unit can be surface-mounted.
 - 1. Fault Current Withstand shall be 20 Amps for 10 seconds, 60 Amps for 3 seconds, and 100 Amps for 1 second.
 - 2. All inputs and outputs shall be galvanically isolated and tested to 2500 Volts AC.
 - 3. The meter shall accept current inputs of class 10: (0 to 10) A, 5 Amp Nominal, and class 2 (0 to 2) A, 1A Nominal Secondary.
- D. The meter shall have an accuracy of +/- 0.1% or better for Volts L-N and Amps, and 0.2% for Volts L-L and power and energy functions. The meter shall meet the accuracy requirements of IEC687 (Class 0.2%) and ANSI C12.20 (Class 0.2%).
 - 1. The meter shall provide true RMS measurements of voltage, - phase to neutral and phase-to-phase; and current, per phase and neutral.
 - 2. The meter shall calculate RMS readings, sampling at over 400 samples per cycle on all channels measured readings.
 - 3. The meter shall utilize 24 bit Analog to Digital conversion.
- E. The meter shall include a three-line, bright red, .56" LED display.
 - 1. The meter must display a % of Load Bar on the front panel to provide an analog feel. The % Load bar shall have not less than 10 segments.
 - 2. The sub-meter must have a programmable display, which allows for the following programming functions including automatic scroll, screen selection programming, and energy scaling.

- F. Sub-meter shall be a traceable revenue sub-meter, which shall contain a utility grade test pulse, allowing power providers to verify and confirm that the sub-meter is performing to its rated accuracy.
- G. The meter shall include 2 independent communications ports with advanced features.
 - 1. Port 1 shall provide an optical IrDA port (through the faceplate) which shall allow the unit to be set up and programmed using a PDA or remote laptop without need for a communication cable.
 - 2. Port 2 shall be selectable for RS485 communication, for 10/100BaseT Ethernet or for 802.11 Wireless Ethernet.
 - 3. When in serial mode, the meter shall speak Modbus ASCII, Modbus RTU, or DNP 3.0 protocol up to 57.6K baud.
 - 4. When in Ethernet mode, the meter shall provide an RJ45 Ethernet connection which shall allow the unit to be assigned an IP address and communicate Modbus protocol over Ethernet TCP/IP.
 - 5. The sub-meter shall have mobile device software available for remote programming and integration.
- H. The meter shall provide user configured fixed window or rolling window demand. This shall allow the user to set up the particular utility demand profile.
 - 1. Readings for kW, kVAR, kVA and PF shall be calculated using utility demand features.
 - 2. All other parameters shall offer max and min capability over the user selectable averaging period.
 - 3. Voltage shall provide an instantaneous max and min reading displaying the highest surge and lowest sag seen by the meter.
 - 4. The Meter shall provide upgrade rate of 6 cycles for Watts, VAR and VA. All other parameters shall be 60 cycles.
- I. The meter shall support power supply of 90 to 400 Volts AC and 100 to 370 Volts DC. Universal AC/DC Supply shall be available and shall have burden of 16VA Max.
- J. The meter shall provide Limits Alarms and Control Capability as follows:
 - 1. Limits can be set for any measured parameter.
 - 2. Up to 16 limits per parameter can be set.
 - 3. Limits shall be based on % of Full Scale settings.
- K. The meter shall have 2 Megabytes data-logging capability and have a real-time clock that allows for time stamping of all the data in the meter when log events are created. The meter shall have five logs:
 - 1. The meter shall have three historical logs for trending profiles. Each log shall be capable of being programmed with up to 64 parameters. The user shall have the ability to allocate memory between the three historical logs in order to increase or decrease the memory allotted to each of the logs.
 - 2. The meter shall have a log for Limits Alarms. The Limits log shall provide magnitude and duration of an event, time-stamp, and log value. The log must be capable of recording to 2048 events.

3. The meter shall have a log for System Events. The System Events log shall record the following occurrences with a time-stamp: Demand Resets, Password Requests, System Start-up, Energy Resets, Log Resets, Log Reads, Programmable Settings Changes.
- L. The meter shall have a standard 4-year warranty.
- M. Power meter shall be able to be stored in (-20 to +70) degrees C.
1. Operating temperature shall be (-20 to +70) degrees C.
 2. NEMA 12 faceplate rating shall be available for the power meter.
- N. The following options shall be included:

Current Input	V-Switch™ Pack	Communication Format
(5 Amp Secondary)	Multifunction meter with 2 Megabytes Data logging	RS485 – Modbus protocol
(1 Amp Secondary)		LAN-based Ethernet

- O. Manufacturers:
1. Company with at least 5 year documented experience and acceptable to the switchboard manufacturer as an OEM.

END OF SECTION 26 27 13

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data for fuses.
- B. Comply with NEMA FU 1.
- C. Comply with NFPA 70.
- D. Project Conditions: Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.
- E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.
- F. Extra Materials:
 - 1. Fuses: Quantity equal to 10% percent of each fuse type and size, but no fewer than three of each type and size.

PART 2 - PRODUCTS

2.1 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

3.2 FUSE APPLICATIONS

- A. Motor Branch Circuits: Class RK5, time delay.

3.3 INSTALLATION

- A. Install fuses so rating information is readable without removing fuse.

END OF SECTION 262813

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SECTION 265210 - EMERGENCY INVERTER SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Single Phase, Online, Solid State Emergency Lighting Inverter System.
 - 1. The inverter shall operate in conjunction with the existing building electrical system to provide high quality power conditioning, back-up power protection and distribution for emergency lighting loads and other critical loads. The system shall consist of an input circuit breaker, solid-state inverter, a temperature compensated rectifier/battery charger, a 100% rated for continuous duty static switch, battery plant, min. (6) output circuit breakers for hardwired load connection, status/control panel, and synchronizing circuitry as described herein.

1.2 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specifications and other Division 26 Specification Section, apply to this Section.
- B. Section 26 08 00 - Commissioning of Electrical

1.3 STANDARDS

- A. The inverter shall meet the requirements of the following standards:
 - 1. IEEE 587-1980/ANSI C62.41 1980 Standards for Surge Withstand Ability
 - 2. FCC rules and regulations of Part 15, Subpart J, Class A
 - 3. Listed under UL 924, Standards for Lighting Inverter Equipment
 - 4. NEMA PE 1 (National Electrical Manufacturers Association) - Lighting Inverter Systems
 - 5. NEMA 250 (National Electrical Manufacturers Association) – Enclosures for Electrical Equipment (1000 Volts Maximum)
 - 6. NFPA 70 – National Electrical Code
 - 7. ISO 9001
 - 8. Occupational Safety & Health Administration (OSHA)
 - 9. NCSBC - 2018 North Carolina State Building Code.

1.4 REFERENCES

- A. NCBCC: North Carolina Building Code Council
- B. NRTL: Nationally Recognized Testing Laboratory.
- C. NEC: National Electrical Code. (NFPA 70)

1.5 SUBMITALS

- A. Submit under provisions of Section 26 00 10.

- B. Shop Drawings: Indicate electrical characteristics and connection requirements. Provide cabinet dimensions; battery type, size, weight and location of conduit entry and exit; single-line diagram, control, and external wiring requirements; heat rejection and air flow requirements.
- C. Product Data: Provide catalog sheets and technical data sheets to indicate physical data and electrical performance, electrical characteristics, and connection requirements.
- D. Upon delivery of the inverter system the following submittals shall be included:
 - 1. An operator and user's manual showing safe and correct operation of all inverter functions.

1.6 QUALIFICATIONS & QUALITY ASSURANCE

- A. Manufacturers Certification: The manufacturer shall specialize in manufacturing of stand-by, double conversion single phase inverter modules specified in this document with a minimum of twenty years documented experience, and with a nationwide service organization. The manufacturer will use only patented ECM technology. The manufacturer shall be certified to ISO 9001 and the inverter shall be designed to internationally accepted standards.
- B. Factory Testing: Prior to shipment the manufacturer shall complete a documented test procedure to test all functions of the inverter module and batteries (via a discharge test) and guarantee compliance with the specification. The manufacturer shall provide a copy of the test report upon request.
- C. Materials and Assemblies: All materials and parts comprising the inverter shall be new, of current manufacture, and shall not have been in prior service, except as required during factory testing. All active electronic devices shall be solid state and not exceed the manufacturers recommended tolerances for temperature or current to ensure maximum reliability. All semiconductor devices shall be sealed. All relays shall be provided with dust covers. The manufacturer shall conduct inspections on incoming parts, modular assemblies and final products.

1.7 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Provide Products listed and classified by a NRTL accredited by the NCBCC to label electrical and mechanical equipment, as suitable for the purpose specified and indicated, where such listing exists.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. All products shall be packaged in a manner to prevent penetration by debris and to allow safe delivery by all modes of ground transportation and air transportation where specified.
- B. Prior to shipping, all products shall be inspected at the factory for damage.
- C. Equipment shall be protected against extreme temperature and humidity and shall be stored in a conditioned or protected environment.

- D. Equipment containing batteries shall not be stored for a period exceeding three months without powering up the equipment for a minimum of eight hours to recharge the batteries.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. The inverter shall operate under the following environmental conditions:

- 1. Temperature:
 - a. Inverter Module
 - 1) Operating: 0° to 40°C (32°F to 104°F)
 - 2) Non-Operating: -20°C to +60°C (-4°F to 140°F)
 - b. Batteries: 25°C (77°F)
- 2. Relative humidity (operating and storage): 5 to 95% non-condensing
- 3. Barometric Pressure:
 - a. Up to 1000 meters above sea level
 - b. Up to 2000 meters with ambient temperature less than 28°C
 - c. Up to 12,000 meters above sea level non-operating
- 4. Audible Noise: 45 DBA at 3 feet

1.10 WARRANTY

- A. Inverter Module: The inverter shall be covered by a full parts and labor warranty from the manufacturer for a period of five years from date of substantial completion.
- B. Battery: The battery manufacturer's warranty shall be a minimum period of one year, with 9 years prorated.

1.11 MAINTENANCE, ACCESSIBILITY AND SELF DIAGNOSTICS

- A. All inverter subassemblies, as well as the battery, shall be accessible from the front only. The inverter shall be equipped with a self-test function to verify correct system operation. The electronic inverter control and monitoring assembly shall be fully microprocessor based.
 - 1. Auto-compensation of component drift;
 - 2. Self-adjustment of replaced subassemblies;
 - 3. Extensive acquisition of information vital for computer-aided diagnostics (local or remote);
- B. The inverter shall be repairable by replacing standard subassemblies. Communication via an RS232 with maintenance system shall be possible.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS/PRODUCT

A. Subject to requirements provide product by following manufacturers or approved equal.

1. Myers Power Products, Inc.
2. ValuSine
3. DSPM
4. UltraLite

2.2 PRODUCT SPECIFICATION

A. Design Requirements

1. Output Power Continuous Rating: The continuous output power rating of the inverter be shall be a minimum 5 KW with the ability to withstand inrush currents produced by the connected emergency lights.
2. Input Voltage: 208 VAC – 15% / +10%, single phase, 3-wire plus ground.
3. Output voltage(s): 120 VAC single phase, 2 wire plus ground.
4. Battery Autonomy: The inverter shall be capable of operating at full load for 90 minutes at unity PF output at a temperature of 25°C on battery power at the end of the battery life of 5 years.
5. Battery Type: Valve regulated sealed lead Calcium (VRLA).
6. Listed by a NRTL to provide emergency power for building emergency lighting per the NCSBC and NEC.
7. Battery runtime shall be 90 minutes at full capacity at the end of a 5-year battery replacement schedule.

B. AC Input Characteristics

1. Input Frequency: 60 Hz
2. Power walk-in: 0 to 100% over a 10-second period.
3. Magnetizing Inrush Current: Less than nominal input current for less than one cycle.
4. Input Surge Protection: The inverter is equipped with standard input filter assembly will withstand surges per IEEE 587-1980/ANSI C62.41

C. AC Output Characteristics

1. Voltage Regulation: + 3% for no-load to full load and full 90-minute battery discharge mode.
2. Frequency: 60 Hz (+ 0.1Hz when free running).
3. Voltage Distortion: Maximum 5% total (THD) @ 100% linear loads.
4. Voltage Transient (Step Load) Response:
 - a. + 5% for 50% step load change
 - b. + 8% for 100% step load change
 - c. + 3% for loss or return of AC input power or manual transfer at full load.
5. Voltage Recovery Time: Return to within 3% of nominal value within 50 milliseconds.

6. Non-Linear Load Capability: Output voltage total harmonic distortion shall be less than 8% when connected to a 100% non-linear load with a crest factor not to exceed 2.5%.
7. Slew Rate: 1 Hz/second maximum
8. Power Factor: Unity power factor.
9. Inverter Overload Capability:
 - a. 125% of rated load for 1 minute
 - b. 145% of rated load for 1 second
10. 1 Bypass Overload Capability: $< 300\%$ for one cycle; $\leq 150\%$ for 30 seconds
11. Four 20 Amp, single phase output circuit breakers for supply of emergency lighting circuits.

D. DC Bus

1. DC Bus Voltage: VDC/cell nominal float level. The battery charger will compensate for temperature changes in accordance with the battery manufacturer's requirements. Inverter will utilize a watch-dog interface software to control DC voltage and extend life of batteries.

2.3 MODES OF OPERATION

- A. The inverter module shall be designed to operate as a double conversion, standby reverse transfer system in the following modes.
1. Normal: The inverter shall be in a stand-by mode ready to supply power to the critical load. The rectifier/battery charger shall derive power from the utility AC source and supply DC power to the inverter and simultaneously float charge the battery.
 2. Emergency: Upon failure of the utility AC power source, the critical load shall be supplied by the inverter, switching within 16 to 60 milliseconds and shall obtain its power from the battery.
 3. Recharge: Upon restoration of the utility AC power source (prior to complete battery discharge), the rectifier/battery charger shall power the inverter and simultaneously recharge the battery.
 4. Bypass Mode: The static bypass transfer switch shall be used to transfer the load to the bypass without interruption to the critical power load.
 5. Manual Bypass Switch: A manual break before make internal bypass switch shall be provided to isolate the inverter output and static bypass and connect the load directly to the utility until service personnel can arrive to repair unit.

2.4 COMPONENT DESCRIPTION

- A. Rectifier / Battery Charger: Incoming AC power shall be converted to a regulated DC output voltage. The rectifier / battery charger shall provide high quality DC power to charge the batteries and power the inverter and shall have the following characteristics:
1. Input Current Limiting: The inverter shall be equipped with a system designed to limit the battery recharge current to conform to UL924 standard.
 2. Modular Assembly: The rectifier/battery charger assembly shall be constructed of modular design to facilitate rapid maintenance.

3. Charging Levels: The battery charging circuitry shall be capable of being set for automatic battery recharge operation, float service and equalizing operation.
 4. Temperature Compensated Charging: The battery charger shall be equipped with a temperature compensated charging and adjust the battery float voltage to compensate for the ambient temperature using a negative temperature coefficient of 3 mV per cell per degree Celsius at a nominal temperature of 25°C.
 5. Capacity: The rectifier/battery charger shall have sufficient capacity to support a fully loaded inverter and fully recharge the battery to full capacity in accordance with UL 924 standard.
- B. Inverter: The inverter output shall be derived from a Pulse Width Modulated (PWM) inverter design. The inverter shall be capable of providing precise output power while operating over the battery voltage range. The inverter assembly shall be constructed as a modular assembly to facilitate rapid maintenance.
- C. Static Bypass: The static bypass transfer switch shall be solid-state, rated for continuous 100% duty.
- D. Microprocessor Controlled Logic: The full inverter operation shall be provided through the use of microprocessor controlled logic. All operation and parameters are firmware controlled. The logic shall include a self-test and diagnostic circuitry such that a fault can be isolated down to the printed circuit assembly or plug-in power assembly level.
- E. Standard Communication Panel: The inverter will include a standard easy to use communication panel. Included will be a LED display. The inverter communication panel will include pushbuttons that will permit the user to safely command the inverter.
- F. Four 20 Amp, single phase molded case circuit breakers for inverter output with integral thermal and instantaneous magnetic trip in each pole for supply of emergency lighting circuits.

2.5 SYSTEM CONTROLS AND INDICATORS

- A. Front Panel LED Display: The inverter control panel shall provide a LED display. The indication of inverter status, metering, battery status, alarm event log and advanced operational features will be available.
- B. System Parameters Monitored (data displayed): The visual display will display the following system parameters based on true RMS metering:
1. Measurements
 - a. Input voltage indicator
 - b. inverter output voltage indicator
 - c. inverter output current indicators
 - d. DC voltage indicators
 2. Status indications and events
 - a. Load on battery
 - b. Load on inverter
 - c. Load on automatic bypass

- d. Low-battery warning
 - e. General alarm
 - f. Additional indications shall provide maintenance assistance
- 3. Time-stamped historical events: This function shall time-stamp and store all important status changes, anomalies and faults and make this information available for automatic or user-requested consultation; it shall interpret the events and indicate remedial measures if applicable.
- 4. DB-9 RS232 Connector: One DB-9 connector utilizing AS400 communication protocol will be provided for field diagnostic actions. Signals provided shall be;
 - a. Inverter/UPS Failure
 - b. Summary Alarm
 - c. Remote Shutdown
 - d. Unit in Bypass
 - e. Low Battery
 - f. Inverter/UPS On
 - g. Line Loss
- 5. Dry Contacts: The inverter shall have dry contacts form "C" to change state to indicate the operating status. The contacts will be rated at 2.0 A (125 VAC / 30 VDC). Contacts shall be programmed as follows. The Inverter fault signal shall be a summary of all conditions that would prevent power output during normal power loss including bypass and low battery conditions:
 - a. Inverter on Line
 - b. Inverter on Battery
 - c. Inverter Fault
 - d. Inverter Bypass
- 6. LED remote annunciator installed at the Front Desk and connected to the installed inverters IN1, IN2, IN3, IN4 and IN5 displaying the following status conditions for all five inverters individually and on one bezel:
 - a. Inverter online
 - b. Inverter on Battery
 - c. Inverter Fault/Bypass

2.6 MECHANICAL DESIGN AND VENTILATION

- A. Enclosure: The inverter shall be housed in a freestanding enclosure. The mechanical structure of the inverter shall be sufficiently strong and rigid to withstand handling and installation operations without risk. Access to inverter subassemblies shall be through the front and top only. The sheet-metal elements in the structure shall be protected against corrosion by a suitable treatment, such as zinc electroplating, powder coating, epoxy paint or an equivalent.
- B. Cable Access: The standard inverter available shall accommodate side, back and bottom entry cables.

- C. Ventilation and Heat Rejection: The inverter shall be designed for forced air-cooling. Air inlets shall be provided from the front bottom of the inverter enclosure. Air exhaust shall be from the top or side portions of the unit.

2.7 BATTERY

- A. The inverter module shall use a valve regulated sealed Lead Calcium heavy-duty industrial battery, designed for auxiliary power service in a inverter application. The primary battery shall be furnished with battery with impact resistant plastic case and housed in the cabinet.
 - 1. Protection against Deep Discharge and Self-Discharge: The inverter shall be equipped with a device designed to protect the battery against deep discharge depending on discharge conditions and with isolation of the battery by a circuit breaker. In particular, a monitoring device shall adjust the battery shutdown voltage as a function of a discharge coefficient to avoid excessive discharge.
 - 2. Battery Self-Tests: The battery monitoring system shall be to perform the following automatic functions:
 - a. Battery circuit check

PART 3 - EXECUTION

3.1 SITE TESTING START-UP

- A. The inverter system will be checked, start-up and tested by a manufacturer's qualified field service engineer.
- B. The Contractor shall provide three (3) copies of the manufacturer's field start-up report.

3.2 MAINTENANCE TRAINING

- A. Owner Training is included with a minimum of 2-hour duration on site covering training from basic inverter operation to inverter maintenance.

END OF SECTION 265210

SECTION 16139 - CABLE TRAYS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes aluminum cable trays and accessories.

1.2 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specifications and other Division 16 Specification Section, apply to this Section.

1.3 SUBMITTALS

- A. Product Data: Include data indicating dimensions and finishes for each type of cable tray indicated.
- B. Shop Drawings: For each type of cable tray.
 - 1. Show fabrication and installation details of cable tray, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice plate connectors, expansion joint assemblies, straight lengths, and fittings.
- C. Coordination Drawings: Floor plans and sections drawn to scale. Include scaled cable tray layout and relationships between components and adjacent structural and mechanical elements. Show the following:
 - 1. Vertical and horizontal offsets and transitions.
 - 2. Cable clearances for access over and to side of cable trays.
 - 3. Vertical elevation of cable trays over floor or bottom of ceiling structure.
- D. Operation and Maintenance Data: For cable trays to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain cable tray components through one source from a single manufacturer.
- B. Furnish products listed and classified by third party agencies accredited by the NBCC to label electrical and mechanical equipment, as suitable for purpose specified and shown, where such listing exists.
- C. Comply with NEMA VE 1, "Metal cable Tray Systems," if cable tray types specified are defined in the standard.

- D. Comply with NFPA 70.

1.5 COORDINATION

- A. Coordinate layout and installation of cable trays and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 MATERIALS AND FINISHES

- A. Cable Trays, Fittings, and Accessories: Aluminum, complying with Aluminum Association's alloy 6063T6 for rails, rungs, and cable trays, and alloy 5052H32 or alloy 6061T6 for fricated parts.
- B. Protect steel hardware against corrosion by galvanizing according to ASTM B 633 or cadmium plating according to ASTM B 766.
- C. Fabricate cable tray products with rounded edges and smooth surfaces.
- D. Sizes and Configurations: Refer to the Drawings for specific requirements for types, materials, sizes, and configurations.

2.2 CABLE TRAY ACCESSORIES

- A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
- B. Barrier Strips: Same materials and finishes as cable tray.
- C. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.3 SOURCE QUALITY CONTROL

- A. Perform design and production tests according to NEMA VE 1.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and 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 CABLE TRAY INSTALLATION

- A. Remove burrs and sharp edges from cable trays.
- B. Fasten cable tray supports securely to building structure as specified in Division 16 Section “Basic Electrical Materials and Methods,” unless otherwise indicated.
 - 1. Locate and install supports according to NEMA VE 1.
- C. Make changes in direction and elevation using standard fittings.
- D. Make cable tray connections using standard fittings.
- E. Locate cable tray over piping unless accessibility to cable tray is required or unless otherwise indicated.
- F. Seal penetrations through fire and smoke barriers according to Division 7 Section “Through-Penetration Firestop Systems.”
- G. Workspace: Install cable trays with sufficient space to permit access for installing cables.

END OF SECTION

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SECTION 16426 - DISTRIBUTION SWITCHBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Main switchboard.
- B. Distribution switchboard.

1.2 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specifications and other Division 16 Specification Section, apply to this Section.

1.3 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.
- B. ANSI/IEEE C12.1 - Code for Electricity Metering.
- C. ANSI C39.1 - Electrical Analog Indicating Instruments.
- D. ANSI C57.13 - Instrument Transformers.
- E. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
- F. NEMA KS 1 - Enclosed Switches.
- G. NEMA PB 2 - Dead front Distribution Switchboards.
- H. NEMA PB 2.1 - Proper Handling, Installation, Operation and Maintenance of Dead front Switchboards Rated 600 Volts or Less.

1.4 SUBMITTALS

- A. Submit under provisions of Section 16010.
- B. Shop Drawings: Indicate front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars per phase, neutral, and ground; and switchboard instrument details.
- C. Product Data:
 - 1. Provide Utility Company's letter indicating available fault currents at the service point and short circuit calculations to indicate expected fault current ampacity at the switchboard service terminals.
 - 2. Provide electrical characteristics as follows:
 - a. Switchboard assembly's fault current withstand rating.
 - b. Voltage.
 - c. Main and section bus ampacity.

- d. Frame sizes of circuit breakers.
- e. Trip ratings of circuit breakers.
- f. Fault current interrupting ratings of components.
- g. Time-current curves of all equipment and components.
- h. Circuit breaker trip and time delay settings to achieve selectivity between feeder circuit breakers at the main switchboard and the main circuit breaker of the sub-panels. Present proposed settings selectivity chart and superimposed trip curves of the series circuit breakers demonstrating selectivity.

D. Test Reports: Indicate results of factory production tests.

E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 26 00 10.

B. Maintenance Data: Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum five years documented experience.

1.7 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by third party agencies accredited by the NCBCC to label electrical and mechanical equipment, as suitable for purpose specified and shown, where such listing exists.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of Section 26 00 10.

B. Deliver in 48-inch maximum width shipping splits, individually wrapped for protection and mounted on shipping skids.

C. Accept switchboards on site. Inspect for damage.

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

E. Handle in accordance with NEMA PB 2.1 and manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Conform to NEMA PB 2 service conditions during and after installation of switchboards.

1.10 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings and as instructed by the manufacturer.

1.11 MAINTENANCE MATERIALS

- A. Provide maintenance materials under provisions of Section 26 00 10.
- B. Provide two of each key.
- C. Provide two fuse pullers.

1.12 EXTRA MATERIALS

- A. Provide three of each size and type of fuse installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Square D.
- B. EATON.
- C. Siemens.

2.2 SWITCHBOARD

- A. Description: NEMA PB 2 with electrical ratings and configurations as indicated.
- B. Main Section Devices: Individually mounted and compartmented.
- C. Distribution Section Devices: Group mounted.
- D. Auxiliary Section Devices: Individually mounted and compartmented.
- E. Bus Material: Copper with tin or silver plating, standard size.
- F. Bus Connections: Bolted, accessible from front only when less than or equal to 24 inches deep and accessible from front and rear when greater than 24 inches deep, for maintenance.
- G. Ground Bus: Extend length of switchboard.
- H. Fusible Switch Assemblies: NEMA KS 1, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in ON position.

Handle lockable in OFF position. Fuse clips: Designed to accommodate Class R fuses, type as specified.

- I. Fusible Switch Assemblies, 800 Amperes and Larger: Bolted pressure contact switches. Fuse clips: Designed to accommodate Class L fuses.
- J. Molded Case Circuit Breakers: NEMA AB 1, integral thermal and instantaneous magnetic trip in each pole.
- L. Molded Case Circuit Breakers with Current Limiters: NEMA AB 1, molded case circuit breakers with replaceable current limiting elements, in addition to integral thermal and instantaneous magnetic trip in each pole.
- M. Current Limiting Molded Case Circuit Breakers: NEMA AB 1, molded case circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 RMS amperes symmetrical let-through current and energy level less than permitted for same size Class RK-5 fuse.
- N. Solid-state Molded Case Circuit Breakers: NEMA AB 1, provide with electronic sensing, timing and tripping circuits for adjustable current settings; instantaneous trip; and adjustable short time trip. Provide stationary mounting. Circuit breakers 400 ampere and larger shall be solid state LSI trip type with ampacity read-out and maximum recording.
- O. Line and Load Terminations: Accessible from the front only when less than or equal to 24 inches deep, and accessible from front and rear when greater than 24 inches deep, suitable for the conductor materials and sizes indicated.
- P. Enclosure: Type 1 - General Purpose.
 - 1. Align sections at rear only.
 - 2. Finish: Manufacturer's standard light gray enamel over external surfaces. Coat internal surfaces with minimum one coat corrosion-resisting paint, or plate with cadmium or zinc.
- Q. Switchboards identified for use as service equipment shall be so labeled.
- R. Switchboards shall be provided with an adhesive tape on front of enclosure to depict actual bus arrangement inside cubicles.
- S. Each switchboard component and circuit breaker shall be provided with adequate engraved phenolic nameplate on front of cubicle indicating purpose and load served. See Section 26 01 95 Electrical Identification.
- T. Switchboards shall be fully fault current rated to withstand maximum available fault current calculated by the utility company. Fault current ratings and interruption ratings shown on drawings are estimates and will be superseded by the utility company's actual available fault current. Series rating is not permitted.

2.3 FUSES

- A. Fuses 600 Amperes and Less: Dual element, current limiting, time delay, voltage to match switchboard, UL Class RK- 1 unless indicated otherwise.

- B. Fuses 601 Amperes and Larger: Current limiting, time delay, 600 volt, UL Class L.
- C. Interrupting Rating: 200,000 RMS amperes.

2.4 AMMETERS AND VOLTMETERS

- A. Switchboards with bussing 800 ampere or larger shall contain a metering section to include Digital power meter / logger. Refer to section 26 09 13 – Electrical Metering.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify conditions under provisions of Section 16010.
- B. Verify that surface is suitable for switchboard installation.

3.2 PREPARATION

- A. Provide concrete housekeeping pad, 4 inches high and 2 inches larger in all directions. Anchor switchboard per manufacturer's recommendations.

3.3 INSTALLATION

- A. Install switchboard in locations shown on Drawings, in accordance with manufacturer's written instructions and NEMA PB 2.1.
- B. Tighten accessible bus connections and mechanical fasteners after placing switchboard.
- C. Install fuses in each switch.

3.4 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 16010.
- B. Inspect completed installation for physical damage, proper alignment, anchorage, and grounding.
- C. Measure insulation resistance of each bus section phase to phase and phase to ground for one minute each, at test voltage of 1000 volts; minimum acceptable value for insulation resistance is 2 Megohms.
- D. Check tightness of accessible bolted bus joints using calibrated torque wrench.
- E. Physically test key interlock systems to insure proper function.
- F. Upon completion of installation, and prior to final inspection, the contractor shall reduce in size the "as-built" single line diagram (riser) with 3/32" lettering, laminate, frame, and mount in a conspicuous place adjacent to the switchboard. A simplified bussing schematic diagram shall be pre-drilled engraved phenolic type with 1/2" lettering and permanently fastened to the switchboard with pop rivets of suitable material.

3.5 ADJUSTING

- A. Adjust all operating mechanisms for free mechanical movement.
- B. Tighten bolted bus connections in accordance with manufacturer's instructions.
- C. Adjust circuit breaker trip and time delay settings to achieve selectivity between feeder circuitbreakers at the main switchboard and the main circuit breaker of the sub-panels. Present proposed settings and selectivity chart of the circuit breakers to the Engineer.

3.6 CLEANING

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

END OF SECTION 16426

SECTION 271000 - INFORMATION TECHNOLOGY SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Information Technology System meeting the UNCW Standards.
- B. Information Technology Structured Cabling System meeting the UNCW Standards.

1.2 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specifications, Divisions 26, 27 and 28 Specification Section, apply to this Section.
- B. Section 26 08 00 - Commissioning of Electrical.

1.3 REFERENCES

- A. NECA (National Electrical Contractors Association) "Standard of Installation."
- B. NFPA 70 National Electrical Code.
- C. STS-1000 Telecommunications Wiring Guidelines.
- D. UNCW-ITS "Infrastructure Standards For Installation" Rev. 06/01/2019.
- E. TIA/EIA-568: Telecommunications Industry Association of the Electronic Industries Alliance (EIA)
- F. IT: Information Technology

1.4 SUBMITTALS:

- A. Product Data for system components
- B. Equipment connection details and electrical power requirements.
- C. Typical device connection details.
- D. System single line diagram including all devices and components.
- E. Terminal schedules

1.5 PROJECT RECORD DOCUMENTS

- A. Record actual locations of Products; indicate actual circuit arrangement.

1.6 OPERATION AND MAINTENANCE DATA

- A. Maintenance Data: Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with EIA/TIA Standards of Installation.
- B. Maintain one copy of each document on site.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Installer: Company certified and in good standing with the manufacturer for the installation, programming, configuring of the products specified in this section with minimum three years documented experience.

1.9 REGULATORY REQUIREMENTS

- A. Furnish products listed and classified by third party agencies accredited by the NCBCC to label electrical and mechanical equipment, as suitable for purpose specified and indicated, where such listing exists.
- B. Conform to requirements of NFPA 70.
- C. Conform to requirements of STS-1000.

1.10 PROJECT REQUIREMENTS

- A. Comply with the applicable requirements of UNCW-ITS "Infrastructure Standards For Installation" Rev. 06/01/2019.

PART 2 - PRODUCTS

2.1 IT COMPONENTS

- A. See Equipment and device schedule on drawings.
- B. Software and licensing needed for system operation and configuration for a minimum of one workstation is included.

2.2 IT STRUCTURAL CABLING SYSTEM COMPONENTS

- A. See Equipment and device schedule on drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Test and demonstrate specified system functions to the owner.

3.2 DOCUMENTATION

- A. Provide complete system documentation including test reports.

3.3 TRAINING

- A. Provide owner system training for no less than 4 hours to cover operation, configuration, interfacing with the system and any detailed questions of the trainees.
- B. Include video recording of owner system training.

3.4 WARRANTY

- A. Provide extended warranty as required by UNCW Infrastructure Standards For Installation.

END OF SECTION 271000

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APPENDIX A

Infrastructure Standards For Installation

University of North Carolina Wilmington, Rev. 06/28/2017

University of North Carolina Wilmington

INFRASTRUCTURE STANDARDS FOR INSTALLATION

Standards as of 06/01/2019

Provided by ITS

IOS / NETWORK & COMMUNICATIONS

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Overview

The University of North Carolina Wilmington is constructing new buildings and renovating existing buildings both on and off main. This document defines voice and data cabling requirements for all future installations. The university recognizes that the integrity of the cabling systems and the use of proper installation techniques by qualified contractors, are essential for implementing a dependable network. Bandwidth requirements and fault tolerance is an important aspect of the structured solution and taken into consideration with the infrastructure design.

Purpose

The university will implement an end-to-end manufacturer's solution that has resulted in the approval of three manufacturers:

1. CommScope SYSTIMAX® Solutions GigaSPEED XL Category 6 Structured Cabling System and Corning Cable Systems LANscape solution
2. CommScope SYSTIMAX® Solutions GigaSPEED X10D Category 6A Structured Cabling System with x91B reduced diameter cable and Corning Cable Systems LANscape solution (Access Solutions)
3. CommScope NETCONNECT/Uniprise® CAT 6 CS37 cabling system and the Corning Cable Systems LANscape
4. CommScope NETCONNECT/Uniprise® CAT 6A CS47 cabling system and the Corning Cable Systems LANscape (Access Solutions)
5. Belden System 2400 (for horizontal cabling). 2412 shall be installed. Key Connect work station outlets and Key Connect patch panels.
6. Belden System 10GXS (for wireless access point cabling). Belden System 3612 and/or 10GXS cabling shall use Belden's REVConnect modular termination system, in appropriate category, supporting either jacks or plugs. Belden System 3600 and/or 10GXS cable shall be installed. Optical fiber system shall be Corning Cable Systems LANscape solution.

This specification is to ensure that UNCW meets with a standards compliant end-to-end cabling solution with guaranteed "Channel" performance. This solution will allow UNCW to maximize productivity and value by minimizing down time and operational expenses, thus warranting our investment for 20 Years, while still providing for a future path to evolving technologies. Each of these solutions requires the contractor to provide Manufacturer certification:

1. CommScope SYSTIMAX Category 6 and Category 6A solutions require the contractor to be a current PartnerPRO network member; installers, supervisors, designers to have a current valid certification.

2. CommScope NETCONNECT/Uniprise Category 6 and Category 6A solutions require contractor to be a current PartnerPRO network member; installers, supervisors, designers to have a current valid certification.
3. Belden solution requires the contractor to be a Belden Partner Alliance (PA) program member.
4. Corning solution requires the installers to be a current EWP.

Solution Description

The SCS Solution shall utilize a network of fiber optic and unshielded twisted pair, riser, ty and station cables. Cables and terminations located as shown and in the quantities indicated on the drawings. Fiber cables shall terminate on wall- or rack-mounted fiber patch panels located in all demarcation and termination points shown on the drawings. All cables shall terminate in an alphanumeric sequence at all termination locations. All standard copper cable terminations shall comply with, and be tested to latest revision of TIA-568-C family of standards for Category 6 and/or beyond Category 6 installations. Horizontal cabling for wireless access points (WAPs) shall comply with, and be tested to latest revision of TIA-568-C family of standards for Category 6A and/or beyond Category 6 installations. Available and unused pairs between the Equipment Room (ER) and Telecommunications Room(s) (TR) shall terminate and identified as spare at each location. Station cables shall terminate on three or four gang wall plates equipped as shown on the drawings. All copper terminations will be T-568B wiring.

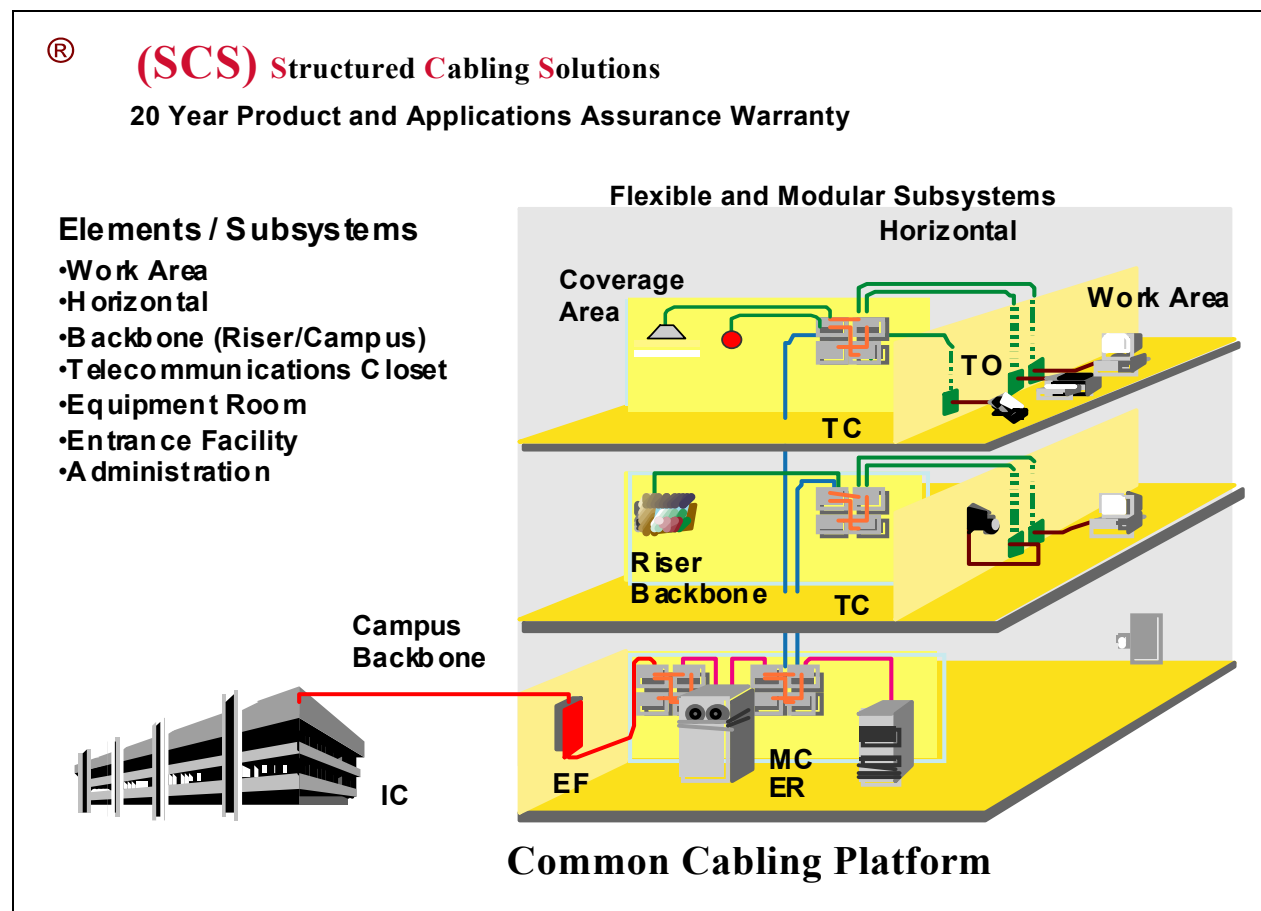
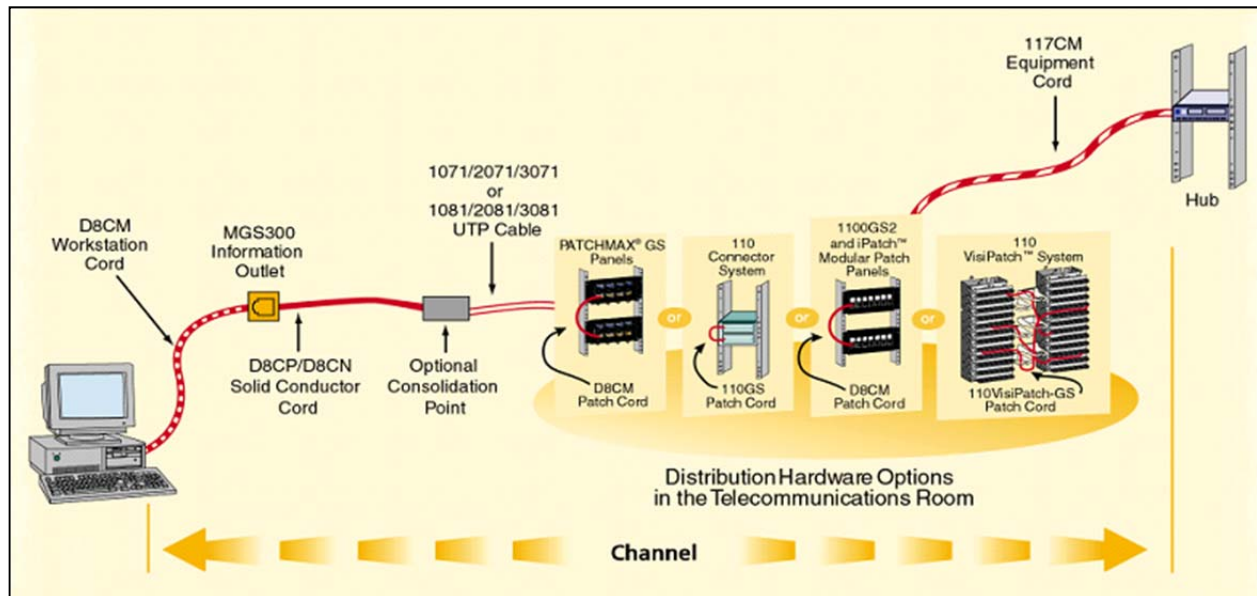


Diagram 1 - Structured Cabling Solution

Channel Performance Specifications

The SCS solution for standard cable drops shall support a useable end-to-end system bandwidth of not less than 400 MHz. This requires substantial performance margin in all key electrical parameters beyond Category 6. Useable end-to-end system bandwidth is indicated by the maximum frequency at which a positive Power Sum Attenuation-to-Crosstalk Ratio may be obtained at both the Near (PSACRN) and Far ends (PSACRF) of a 100-meter cabling channel. This channel shall have the capability of four or six connections without failing to meet Category 6 specifications.

The required cabling system described is a “Beyond Category 6” structured cabling solution.



The SCS solution for wireless access points (WAPs) shall support a useable end-to-end system bandwidth of not less than 500 MHz. This requires substantial performance margin in all key electrical parameters beyond Category 6A. Useable end-to-end system bandwidth is indicated by the maximum frequency at which a positive Power Sum Attenuation-to-Crosstalk Ratio may be obtained at both the Near (PSACRN) and Far ends (PSACRF) of a 100-meter cabling channel. This channel shall have the capability of four or six connections without failing to meet Category 6A specifications.

The required cabling system described is a “Beyond Category 6A” structured cabling solution.

Installation Specifics

The installation contractor shall be responsible for installing, terminating, testing, and labeling the cabling system in accordance with TIA and BICSI installation guidelines for intra and inter building. The contractor will also provide UNCW with a dedicated project manager for the life of the project who is responsible for planning the installation schedule and act as the interface with UNCW employees. Weekly update meetings will be required. The contractor will also provide UNCW with the certified installation warranty certificate at the completion of the project. This will insure that UNCW will be able to maintain a warranty on their installed communication systems.

A single manufacturer shall provide all unshielded twisted pair (UTP) end-to-end Channel (as defined by latest revision of TIA-568-C family of wiring standards) configurations. The horizontal cabling to station outlets shall consist of UTP, riser rated (CMR) cable at a minimum.

Each standard data cable shall be 'Beyond' Category 6 rated to a minimum of 400 megahertz and shall be third party verified to comply with or exceed TIA Category 6 requirements.

Each cable for wireless access points (WAPs) shall be a "Beyond" Category 6A cable rated to a minimum of 500 MHz. Each cable for WAPs shall be third party verified to comply with or exceed Category 6A requirements, and shall carry be capable of supporting 100W Power-Over-Ethernet over 100 meters.

References for the project and standards shall be as required to include:

- A. TIA-568-C.2 (or latest revision)
- B. TIA-569-D (or latest revision)
- C. TIA-606-B (or latest revision)
- D. TIA-607-C (or latest revision)
- E. NETA ATS (or latest revision)
- F. NFPA 70 (or latest revision)
- G. UL 969 (or latest revision)
- H. ISO/IEC 11801 (or latest revision)
- I. BICSI TDMM (or latest revision)
- J. BICSI CO-OSP (or latest revision)
- K. STS-1000 (or latest revision)
- L. Standards of Installation of Infrastructure Network Communications at UNCW

Number of Drops per Room

Faculty/Staff Offices, Class Rooms, Conference Rooms

Will have a minimum of four (4), beyond Category 6 rated and one (1) - coax terminated on a video coupler insert or campus wide access outlet as determined on the print.

Additional drops installed as requested. Each horizontal UTP cable shall terminate on one RJ-45 jack at the workstation. The termination method on the rear of the jack shall be Insulation Displacement Contact (IDC) type connectors. The pin assignments shall conform to TIA-568-B standard T568B. Rooms less than 100 square feet will have one (1) standard information outlet and rooms 100 square feet or more will have two (2) information outlets. An information outlet is two (2) voice and two (2) data.

Each information outlet will have a minimum of two (2) voice and two (2) data outlets.

Wall phone locations

Wall telephone outlets shall use Suttle 063187 or approved functional equivalent. The wall phone jack will be stainless steel and have mounting lugs with screw down termination. The mounting position will provide enough room for a standard wall phone w/ADA jack beside it.

Data Projectors

Each data projector will have a minimum of three cat 6 or beyond data cables installed.

A/V Equipment Racks

Each rack will have a minimum of five cat 6 or beyond data cables.

TR Inter-connects

Will have a minimum of three (3), Cat 6 for each Closet. Also an additional cross-connect for every twenty-four (24) installed Cat 6 jacks beyond the first twenty-four (24) connections.

Print Machines

Will have a minimum of one (1) dedicated Cat 6 for each device.

Vending Machines

Will have a minimum of one (1) dedicated Cat 6 for each device.

Irrigation Clocks

Will have a minimum on one (1) dedicated Cat 6 with in line protection installed (Ditek or equivalent). The installation will determine the cable used to meet code.

Water Meter(s)

Each water meter will have a minimum of one (1) dedicated cat 6 to each location. Installation of one voice line will be required in addition to the data line.

JACE (HVAC) Communications

Each JACE location will have a Standard drop on One (1) voice and two (2) data. The standard drop is within two feet of the JACE location.

Freezer Location

Will have one (1) standard drop for each location.

Television Location and Monitor Locations

Will have two (2) data outlets and one (1) standard RG-6 Coax cable installed.

Intercom Cabling

Each Intercom unit will have one (1) dedicated data cable from the data rack in the Communications room.

Wireless Access Point Outlets

Conference and Auditorium

16 to 25 seat- 2 outlets

25 to 30 seat- 3 outlets

30 to 50 seat-4 outlets

50 to 75 seat-5 outlets

75 to 100 seat- 6 outlets

Work rooms – 2 outlets

Hallways – every 100 feet

Main Electrical rooms- one per room

Primary Mechanical rooms- one per room

Wireless access points shall terminate on a dedicated 6A patch panel that matches the structured cabling solution being installed.

Cable Installation

Cabling Termination practices: The installer will observe the cabling practices described in the TIA-568-C family of standards. Standard industry practices guided by the latest revisions of BICSI TDM and BICSI installation manuals are required for cable installation, handling, grooming, etc. Installation of cabling is in a manner that will protect the cable from damage during install, facilitate cable management and identification and provide a neat and groomed appearance. The horizontal cables shall be bundled in the ER/TR ladder tray using Velcro cable ties. Plastic ty-wraps are

unacceptable. During the installation, nicks, abrasions, burning, and scuffing of cable are unacceptable and will be prevented. Replacement of damaged cables are at the contractor's expense regardless of whether the cable passes Category 6 Level III testing standards.

Cross-connect fields

110 or GigaBIX IDC connecting clips or blocks for every installed cable pair at the rack and WAO.

Horizontal station cable

Should have twelve inches of spare cable at the station outlet and 10 feet of spare at each rack

Category 5e power sum cables and fiber riser cable between the ER/TR

Outside plant Category 3: Eight feet spare at each protector block.

Fiber terminating into the building: as per industry best practices, last 15 feet of fiber cable to be cut off and discarded after pulling, still leaving 20 feet of spare at each rack.

Network Data Connections

Manufacturer certification is required for installers. Information outlet terminations will be to manufacturer's specifications. The installer is responsible for end-to-end termination of all the cabling.

All data cable is blue in color unless changed by environmental standards.

Network and Communications – Telephony

All voice cable shall be Category 6 or beyond Category 6 rated. Telecommunication's voice cable is white jacketed. Manufacturer certification is required for installers. Information outlet terminations will be to manufacturer's specifications. The installer is responsible for end-to-end termination of all the cabling.

Telephone Trunk Cables

Cables of 25 pair and up are 24 AWG, LSPR Power Sum (Category 5e) solid conductor cables. These high pair-count cables terminate on 110-style 360 pair for the SYSTIMAX system, the Belden termination solution or the NECTONNECT Category 5e solution. The punch-down order is the traditional USOC color code order for Multi-pair telephone cables Punched on 110 blocks with insulation displacement connectors installed. All terminations will be on a dedicated voice rack.

Jacks (inserts, all installations)

Category 6 jack data jacks are yellow in color

Category 6 jack telecommunications voice jacks are white in color

When specifying Belden copper systems, jacks and modular plugs shall be from Belden's Key Connect & REVConnect product family. REVConnect is only for WAP locations.

CATV video coupler kits are white in color.

Work Area Outlet (WAO) faceplate is white with a minimum of four ports with label insert top and bottom.

Campus Copper Voice Backbone

The connection for each building on campus is with a PE-89 rated outdoor copper cable consisting of a minimum of 25 pairs. Termination shall be consistent with the units used for the voice backbone. Terminations will be on protector blocks with 110 in/110 out. Each pair on the protector block use 4c1s 5 pin solid-state protector modules. The underground or inter-building cable installation, termination, and testing by the voice /data contractor.

Campus Fiber-Optic Data Backbone

From the MDF to the IDF(s)

The data cables used between the MDF to the IDF(s) will be a fiber-optic cable consisting of a minimum twelve single-mode fibers. The number and type of fiber and quantities required are according to the existing and future network requirements. The existing cables are Siecor or Corning Cable Systems fiber optic cable and terminated with LC connectors mounted in Corning Cable Systems LANscape rack-mounted hardware in the top position of the data rack. All twelve strand fibers must terminate in twelve port interconnect panels.

Between Buildings

Existing buildings use Corning Cable systems duct/aerial hybrid loose-tube fiber-optic cable. Existing hardware is the Corning Cable systems landscape rack-mounted hardware. The University, according to the existing and future network requirements will specify the number and type of fibers.

UNCW is a splice free fiber optic campus. Fiber optic cable splicing is unacceptable for any fiber optic cabling: outside plant or Intra-building.

Outside plant, fiber will terminate in Data rack fiber patch panels in each MDF.

Backbone fiber will terminate in each MDF and TR in a data rack fiber patch panel, either Corning Cable Systems LANscape.

This backbone cable shall consist of a minimum of 24 single-mode fibers.

The cable termination is with LC connectors and rack-mounted hardware.

The minimum count is 24 single mode fibers.

Communications Room/Equipment Room

The ER/TR(s) for each building provide for a transition between the horizontal and backbone pathways, and provide space for Network communications components including cable terminations (horizontal and backbone), active and passive equipment, cross-connections cabling, and hardware, and any other materials or equipment associated with the building Network communications, data and technology systems. All Communications Rooms shall have direct access to the hallway or other such corridor. Network communications rooms are dedicated space. Building services such as Electrical (i.e. Electrical Distribution Panels or Transformers) poses a threat of damage or EMI interference that makes them completely unacceptable for Network Communications Equipment and wiring. Supporting codes are in the TIA-568B-C and TIA-569 wiring standard unequivocally against Multi-Use Communications rooms. In existing buildings, due to age of the building and design criteria at that, time space shared with other trades exists until the building's renovation or space is available.

1. Network communications doors should not open into network communications Rooms.
2. Network communications Rooms shall not contain any type of sink or storage for Custodial or any other such supplies.
3. Network rooms MDFs, IDF: - do not allow storage of any kind (i.e. Books, Furniture, A/C Filters, Light Bulbs, AV Equip. etc....).
4. Floors in Network Communications Rooms shall be sealed concrete or tile. Carpeted floors are totally unacceptable for Network Communications rooms due to the associated static electricity they create posing a threat of damage to sensitive Network Electronics.
5. A minimum space of 10 ft. X 10 ft. X 8 ft. H is required for all Network Communications Rooms or as required by TIA-569-A designs considerations. Square foot size: 10,000: 10 ft. X 11 ft.; 8,000 sq. ft.: 9 ft. X 10 ft. and 5,000 sq. ft.: 7 ft. X 10 ft.
6. All walls of the Network communications room are covered in ¾" non- fire rated plywood horizontally, be void free and finished on one side; mounted 4 inches above finish floor (AFF) the total perimeter of the room. The Non-fire rated plywood has at least two coats of fire resistant white paint. The paint applied is on all six sides with a minimum of two coats. The final paint finish shall be clear of footprints, markings, etc. and be a smooth finished product. NO exceptions. The plywood will be mounted eight (8) foot vertically and four (4) foot wide around the entire communications room.

7. All Network Communications locations shall be equipped with a grounding bus bar. A solid copper grounding bus bar ¼-inch thick x4 inches high with compression fittings and standoff brackets with insulators will be required on the Network communications backboard.
8. Bus bar connection is to a backbone of insulated, solid copper (minimum #6 AWG, with 3/0 recommended). This backbone is to the main grounding bus bar in the electrical entrance facility that bonds back to the building's grounding system. This point should be at an electric panel per NEC 2005 standards. Chatsworth grounding bar 10622-010 or equivalent. The grounding bar location is mounted above the horizontal cable tray in the TR.
9. Each telecom Room connection to the MCC has a minimum of eight LSPR Power Sum Cables (Category 5e). Cables that installed outdoors will be PE-89 type and terminated on 110 in/ 110 out building protectors at each end. Each building entrance protector will be fully loaded with C4B1S (PTC) solid-state protector modules. The pair counts used for this backbone will vary by project due to connection requirements.
10. Each rack will also house a minimum of one (1) rack-mounted surge suppressor or UPS as specified on the print.
11. TIA-569-D Standards usage for lighting, HVAC, perimeters and dust design are required.
12. Fire Alarm panel installation in the TR or the ER not permitted.
13. Electrical outlets mounted at eighty-two (82) inches above AFF to top of outlet.
14. All electrical outlets are on the emergency generator. If the building does not have an emergency generator circuit prepping for future installed is required.
15. Installation of electrical conduits, refrigerant pipes, water pipes, HVAC ducting or piping, elevator alarms or pump alarms cannot penetrate through the communication or ER rooms.
16. Dedicated duplex 20 amp 110 VAC outlets on separate circuits are required. Convenience outlet mounting is at six foot. Intervals around the perimeter.
17. One- L6-20P outlet is required. Outlet is mounted at eight-two (82) inches AFF.
18. To improve visibility all walls are white in color.
19. HVAC: 24 hours/day, 365 days a year, 64 degrees to 75 degrees Fahrenheit, 30 to 55% humidity, positive pressure.
20. Lighting: Typically, 8.5 ft. high providing 50 ft. candles @ three feet above the floor.
21. Dust: less than 100 micrograms/cubic meter/24-hour period.
22. Audio Visual (AV) Cabling: AV cabling shall not use the communications rooms: MDF, IDF, and Entrance Facility as a pathway due to legal and

- auditing problems. The AV cable for riser pathways needs its own dedicated pathway. AV equipment storage is not allowed.
23. Intercom units: The single data line for each intercom unit is a standard data cable and terminate in the communications room data rack. Network Communications maintain the cable. AV maintains the power supply and must be located in a dedicated area separate from the communications rooms.
 24. Sleeves and Pathways for Communications, data, and fiber optic cabling is dedicated and not to be used by other trades. Each trade is responsible for providing a dedicated pathway that meets code. Ty-wrapping or attaching to communications pathways or supports is not allowed.
 25. Racks are two post open frame with three (3) inch deep channel, seven (7) feet in height, nineteen (19) inches wide and have a total of forty-five (45) RU's. Vertical cable management will be a minimum of six (6) inches wide and six (6) inches deep, double sided with covers. Each rack will have a vertical cable manager per side. If two (2) racks are side by side the total Vertical cable manager's width will be twelve (12) inches wide.

Patch Cords

The qualified contractor will provide all patch cords for the project. The following criteria apply:

1. Patch cords are included in the project and provided by the voice/data contractor for the rack end and the work area outlet(s).
2. Patch cords must be manufactured by the selected end-to-end system manufacturer and must be of correct grade to maintain the beyond Category 6 or beyond Category 6A channel rating.
3. Installation of the patch cords will be by the contractor after review with Network communications.
4. Patch cords for the work area outlet will be 50% 15 feet, 50% 20 feet. Unless otherwise designated by the Network communications department. The quantity for the Work area outlets will be for all Network communications data outlets throughout the facility.
5. Patch cords for each data cable in the data rack(s) of all communications rooms. At the rack end, the patch cords will be 40% 2 feet, 40% 3 feet, and 20% 4 feet.
6. Category 6A patch cords provided by contractor for each wireless access point. The length is a minimum of 5 feet and the quantity is for each wireless access point. The patch cord for the rack end will be included in the data cable quantity.
7. Patch cords will be from one supplier and match the end-to-end solution installed for the project.

8. Patch cords submittals are included for review and include lengths and quantities.

Cable Pathways

Pathways constructed from J-hooks maybe hung from Ceiling Wire installed with powder-actuated devices. J-Hooks will not be attached to independent grid wire or to the existing drop ceiling grid wiring. The added weight to the ceiling grid system can cause distortion in the grid system. Cable tray usage is for horizontal pathways with options including channel tray, ladder tray, solid bottom, and ventilated. Cable tray with conduit from the wall, stubbed within 6 inches of the cable tray and bonded is the preferred method. Conduits will have a 200 lbs. minimum pull string installed regardless of the length of the conduit. The horizontal cable between the ER/TR and the station outlets may have different support methods.

Proper Use of J-Hooks

Ceiling support shall not exceed manufacturer specification for Category 6 compliance. The maximum span distance will not exceed 5 feet intervals with a maximum of 12 inches of sag between supports. There shall be a minimum distance of 3 inches between the cable support distance and ceiling grid. Cable pathways design is to avoid EMI and RFI Interference. Common causes of this interference are fluorescent lighting fixtures, air handling motors, and many kinds of electrical controls including starters, lighting contractors, and power distribution panels. All cable runs must be at least two feet away from all fluorescent lights and EMF sources. Never run parallel with electrical conduits or strap to them. Every cable, whether an individual or grouped together, shall be supported. Wherever possible, group cables together in pathways. Never cinch plastic cable ties overly tight. If it deforms the outer cable jacket, it is too tight. The ties should be trimmed of any excess length and be snug. Cable splicing is not permitted and violation corrections will be at the contractor's expense.

Unsuitable Conduit

During cable pulling, flexible conduit tends to:

- o Creep
- o Shift
- o Cause sheath damage to the cable

Flexible conduit usage is only in situations where it is the only practical alternative.

NOTE: If flexible conduit is used, its size increases by one trade size relative to the size of a rigid conduit.

IMPORTANT: Flexible conduit (e.g., metal flex conduit) usage in buildings not recommended.

Acceptable conduit runs

Achieve the best direct route (e.g., usually parallel to building lines) with no bend greater than 90 degrees or an aggregate of bends in excess of 180 degrees between pull points or pull boxes. Contain no continuous sections longer than 30.5 m (100 ft.). Conduit bonding is to ground on one or both ends in accordance with national or local requirements. Conduit type selection is to withstand the environment and meet code for installation. NOTE: For runs that total more than 30.5 m (100 ft.) in length, pull points or pull boxes installed so that no segment between points/boxes exceeds the 30.5 m (100 ft.) limit. Total conduit runs kept to 45.8 m (150 ft.) or less (including the sections through pull boxes).

Identification and Labeling

The contractor with the following criteria will provide labels. Each end of all Category 6 cable labeled at approximately 3 to 6 inches from the Network Data/voice jack, CATV, and with a printed cable label. The contractor with consultation will provide labeling for the faceplate and block terminations from the Information Technology Network Group. All labeling will comply with the TIA-606A standard. The ER/TR labeling nomenclature will match that of the station outlet (SO) identifier as shown in the following information.

1. Rack- mounted 110-block labeling: Each 110-block position (each 4-pair connector clip) will be labeled as follows: Standard SOs/ wall phones outlets FVXX- where FVXX is the SO identifier where the Category 6 or beyond Category 6 cable on that connector clip terminates.
2. Modular patch panel labeling: Each panel has labeling. Each modular jack panel position shall be XXX where XXX matches the SO identifier. The patch panel shall have a label placed on the upper left hand corner of the panel face identifying the panel. All labels for the labeling printed using a computer, printer or Brother p-touch labeler with the TZ tape or equivalent. LABELS SHALL NOT BE HAND WRITTEN. Labels shall be different colors as detailed for identification per the 606B standard. The contractors shall meet with UNCW Telecom personnel, verify the numbering schemes, and label coloring.
3. The general numbering sequence shall conform to a sequential numbering pattern common to all floors of the facility. All cable numbering is sequentially from room to room as closely as possible. The final numbering scheme agreement is between the selected vendor and the building owner, UNCW prior to the start of the physical installation.
4. Station outlet labeling consists of two components: top faceplate label and a bottom faceplate label. The label will consist of a five-character identifier with the format f-y-xxx. F= the floor number of the building, y is D for data or V for voice and xxx is a unique identifier between 0 and 999 for any station outlet on that floor served by the same ER/TR. Faceplate labels for wall phones will consist of 4-character identifier with the format f-v-xxx. F= the floor number, V = is for voice, xx is a unique identifier between 0 and 99.
5. TIA-606 Administration standards for the Network Communications Infrastructure of Commercial Buildings is an incorporated reference. Compliance and shall be maintained.
6. Each cable record must indicate the cable type by manufacturer and manufacturer's designation and document every pair/conductor in the cable. Cable identifier linkage is to all pathways in which it runs.
7. Each piece of termination hardware such as a patch panel or wiring block must be unique named and labeled.

8. Termination position on cross-connect must be identified by type, the pair conductor terminated and a user code.
9. Each element in the route, identification labels should be completed and attached. Labels should meet the requirements of UL969 Standard for Marking and Labeling Systems.
10. A final report should record system configuration, unique identifier, fiber labels, pathways, as-built details, and as-built drawings.
11. Loss Measurements and OTDR traces shall also be included. With the records.
12. Color coding to match 606 requirements.
13. Cable numbering shall follow the example:

D=DATA, V=VOICE
5=NETWORK COMMUNICATIONS ROOM NUMBER
2=FLOOR NUMBER
013=13TH CABLE TO BE INSTALLED
CABLE D.5.2.013
14. Wireless access point labeling: label the grid work at the outlet location with a printed label. Provide WAP in front of the horizontal cable label at the rack end. A green dot on the grid work is for easy location identification.

Example: WAP D.5.2.013

Fiber Labeling

1. The interconnect panel will be labeled on the front glass of the enclosure and include:
 - a. Size and type of the fiber.
 - b. The far end or "TO" will be shown
 - c. The building the fibers termination point location is.
 - d. The Enclosure will be identified.
 - e. The interconnect panel will be identified.
2. Panel A 12 SM to (bldg. abbreviation) Enclosure (A thru Z identified on enclosure) to Panel A thru Z identified on enclosure)
3. EX. Panel A 12 SM to TSC Enclosure D Panel G.

Testing, Documentation and Warranty

Copper category 5e and/or 6 channels shall be tested as appropriate, with only PASSing values accepted, using a TIA-568-compliant Cat 6 Time-Domain Reflectometer. Copper category 6A channels shall be tested, with only PASSing values accepted, using a TIA-568-compliant Augmented Cat 6 (Cat 6A) Time-Domain Reflectometer.

Horizontal Cable Testing

1. Channel testing: Each equipment Network communications room patch cord, patch panel, horizontal cable, RJ 45 jack, Station patch cord will be tested end-to-end for compliance with category 6 level III parameters as stated in the TIA-568 family of standards. Only certified cat 6-cable testing allowed on each all beyond cat 6 cables. The Test equipment used for horizontal category six cable tests complies with the industry standard Category 6 cable testers level III and comply with TIA test procedures. Each link shall be tested to TIA-568-C pinout, with only PASS results accepted. The contractor, at no charge to UNCW, shall bring any pairs not meeting the requirements of the standard into compliance and complete end-to-end test results documentation to UNCW. The test results will require 2-cd copies.

Fiber Optic Testing

Each 62.5 OR 50/125-micron fiber will be tested patch panel to patch panel at the 850 and 1300 nm wavelength in both directions using a light meter. Each single mode fiber will be tested patch panel to patch panel at the 1310 and 1550 nm wavelength both directions using a light meter. The maximum total attenuation for any single fiber between patch panels will not exceed 3.0 db.

- o Power meter tests: For building risers, power meter tests are required.
- o Provide a power test and OTDR test for length, attenuation, and micro bends for each individual fiber. Documentation will include the power test and OTDR results.
- o Test results included for inclusion into the documentation package.
- o Link attenuation does not include any active devices or passive devices other than cable connectors and splices.
- o A final report shall be compiled that records system configuration, fiber labels, cable routes, and as-bilts details and as-built drawings.

Computer Generated Report

All cables/connectors shall be tested provide test equipment generated print out for each cable/connector, indicating that the channel end-to-end solution has passed or failed. Test results: Provide two cd copies.

All testing must meet manufacturer's warranty requirements.

Manufacturer Warranty

Contractor shall provide a minimum Twenty (20) year cabling Extended Product Warranty and Application Assurance. The warranty will support any performance claims the manufacturer makes over and above the Cat. Six standards stated herein. A Warranty statement from the Manufacturer stating the period of the warranty for all the products specified for the project and the name and address of the authorized manufacturers agent who will honor the warranty claims.

Extended Product Warranty

The Extended Product Warranty will cover product defects for all passive manufactured channel components. Passive components are those exhibiting no gain or contributing no energy. Manufacturer warrants, from the date a Registration Certificate passes to the end-user, the following:

1. That the passive products that comprise the registered Channel solution will be free from manufacturing defects in material or workmanship under normal and proper use;
2. That all channel approved passive cabling products that comprise the registered channel solution exceed the specification of TIA 568 and exceed ISO/IEC 11801 standards and will be equal to or exceed to the performance specifications of the associated Communication product data sheet in effect at the time the Registration Certificate is issued;
3. That the installation will exceed the insertion and return loss, attenuation and near end cross talk (NEXT) requirements of TIA 568-B and the ISO/IEC 11801 standards for cabling links/channel configurations specified in these standards.
4. That each channel is comprised exclusively of a single manufacturer solution and is capable of delivering 1.2 Gbps (Cat 5e), 3.6 Gbps (Cat 6) or 10 Gbps (Cat 6A) to the workstations or WAPs in accordance with applications standards.
5. This extended Product Warranty is applicable to the channel cabling solution products only on the original site of installation. Under the Extended Product Warranty, Manufacturer will either repair or replace the defective product itself at Manufacturers' cost. The U.S.A., Manufacturer will pay an Authorized cable installation Reseller for the cost of labor to repair or replace any such defective product on behalf of Manufacturer.
6. Corning Cable Systems LANscape solutions "landscape extended warranty" a 25-year guarantee on complete fiber optic cabling solutions. The telecom contractor shall be an authorized Corning Cabling Systems extended warranty (NPI) installer.

Application Assurance

Application Assurance covers failure of the channel SCS to operate the applications, that the Solution is to support, as well as additional application(s) included in the numbered list. Manufacturer warrants that the registered channel SCS solution will be free from failures which prevent operation of the specific applications for which the original channel SCS was designed. The Application Assurance Program also covers the following additional applications:

1. Those identified in the current (at the time of installation) channel SCS Performance Specifications; and
2. In accordance with application standards specifications, any applications introduced in the future by recognized standards or user forums that use TIA/EIA 568 or ISO/IEC 11801 components and link/channel specifications for cabling.
3. The contractor's certifications are current for the manufacturer's solution installation. The contractor shall provide standards compliant, warranted, end-to-end channel solution for structured cabling solutions.

Additional Warranty

Contractor shall state any additional Contractor supplied warranty. This contractor warrants the Network communications cabling infrastructure system to be free of defects in the materials and workmanship for the period of one year after the date of final payment. The effective date of this warranty applies to all components of these systems regardless of any equipment manufacturer's warranties, which may expire at an earlier date. Any system malfunctions or any previously undiscovered non-compliance with the plans and specifications during the warranty period are repaired at no cost to the Owner are brought into compliance.

Self-Install Warranty: The beyond cat 6 structured cabling manufacturers shall issue The University of North Carolina at Wilmington a Self-Install Warranty for all future moves, adds and changes that are warrantied under this contract document 'Extended product warranty and application assurance program for an end-to –end channel solution'.

Inspection

The Project Manager and/or the SCS System Manager shall perform on-going inspections during construction. All work performed is in a high-quality manner. In addition, the overall appearance shall be clean, neat and orderly. These items need to meet compliance:

1. Is the design documentation complete- Are all the cables properly labeled, from end-to-end?
2. Have all terminated cables been properly tested in accordance with the specifications. Testing includes for the specific category as well as tested for

opens, shorts, polarity reversals, transposition and presence of AC and/or DC voltage?

3. Is the cable type suitable for its pathway? Are the cables bundled in parallel?
4. The manufacturer's pathway Guidelines are used. Is all cable penetrations installed properly and fire stopped according to code?
5. Have the Contractors avoided excessive cable bending?
6. The potential for EMI and RFI sources been considered?
7. Is Cable Fill Ratio Correct?
8. Are hanging supports within 1.5 meters (5 feet)?
9. Does hanging cable exhibit some sag?
10. Are Network communications room terminations compatible with applications equipment?
11. The patch Panel instructions are followed?
12. Jacket removal point.
13. Termination positions.
14. All pair terminations tight with minimal pair distortions.
15. Twists maintained up to Index Strip.
16. The Modular Panel instructions been followed?
 - o Cable dressing first
 - o Jackets remain up to the Connecting Block
 - o All pair terminations tight and undistorted
 - o Twists maintained up to the Connecting Block
17. Connectors are correct side- up in the Jack Panels without cables wrapped or twisted around the Mounting Collars.
18. Are the correct outlet connectors used (T568B)?
19. That the jacket maintained right up to the manufacture specifications.
20. Are identification markings uniform, permanent and readable?

Damages

The contractor is responsible for all damages to portions of the building caused by it, its employees or subcontractors including but not limited to the following:

1. All damage to any [portion of the building caused by the movement of tools, materials or equipment.
2. All damage to any component of the construction of spaces "turned over" to the contractor.
3. All damage to the electrical distribution system and/or other space "turned over" to the contractor.
4. All damage to the electrical, mechanical and/or life safety or other systems caused by inappropriate operation or connections made by the Contractor or other actions of Contractor.

5. Other damage to the materials, tools and/or equipment of UNCW, its consultants, General Contractor, subcontractors, Architect, other contractors, agents and leases.

Recorded Documents

Prepare record documents in accordance with the requirements in Division 27 Section "PROJECT CLOSEOUT". In addition to requirements specified in Division I, indicate installed conditions:

1. Backbone and horizontal cabling, station outlets, layout of ER and TR, all labeling of all cabling, connectors, equipment, conduits, cable trays, etc.
2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
3. Approved substitutions, contract Modifications, and actual equipment and materials installed.

Documentation

The cabling contractor shall provide the following documentation to the owner within 2 weeks following the completion of the installation:

1. Marked up floor plans identifying as-built cable routing for all horizontal backbone cabling. Submitted in electronic format (AutoCAD) and hard copy print out.
2. Marked up floor plans with station outlet identifier listed adjacent to each station outlet. Submitted in electronic format (AutoCAD) and hard copy print out. In addition, the contractor will provide full size laminated prints or framed prints installed by the contractor in each ER and each TR. All required full size drawings installed as required in each TR and ER to reference all station outlets served by a specific ER or TR.
3. Test results for each jack in each station outlet compiled in a binder with the tests listed in numerical order grouped by ER/TR. Provide two CD copies.
4. Tests results for all horizontal and backbone UTP, Co-Ax and fiber cables compiled in a binder with the tests grouped by the backbone cable. Provide two 8-1/2 x 11 hardcopies in notebooks and 2 CD copies.
5. A scaled plan of each building showing the placement of each individual item of equipment as well as raceway size and routing, junction boxes, and conductor size, quantity, and color in each raceway.

Quality Assurance

Installers Qualifications: Contractor with a minimum of five years documented successful installation experience on projects utilizing cabling infrastructure work similar to that required for this project. The contractor shall be an experienced firm regularly engaged in the layout and the installation of cabling infrastructure systems. The contractor must be able to show evidence that he has successfully completed projects of similar size and scope in the last 12 months. The contractor shall be a manufacturer certified Business Partner, CVA, or for the TE solution the installers, supervisors, registered certifier, and designers to have a current valid certification card.

1. The Network Communications project manager must have experience in this type of project and he/she expected to provide technical support.
2. The Network Communications project manager shall attend the monthly progress meetings held by the state and additional meetings as scheduled or required.
3. BICSI registration must be current and the installer and technicians must be in good standing.
4. During the shop drawing process, provide copies of all manufacturer and BICSI certifications, the contractor shall meet the following criteria: 15% of work force shall be BICSI certified 'Technician level or better (RCDD). 15% of work force shall be BICSI certified Installer level 2 or higher; 15% of work force shall be BICSI certified installer level 1 or of equivalent experience/training.
5. Contractor employees will wear visible ID badges on the job site with current picture and company name at all times.

General Requirements

1. Work under this section shall include providing all labor, materials, equipment, and services necessary for and reasonably incidental to the proper completion of all Network communications work as shown on the drawings and herein specified. Work shall also include, but not be limited to the furnishings, unloading, handling, distribution, setting, supporting, and installation of all required components.
2. Refer to electrical drawings for each buildings equipment room, Telecom room (TR) and station outlet location.
3. Refer to the Network communications riser diagrams and diagram drawings for the following:
 - a) Outlet elevation: showing all components required for the installation and mounting of the outlet. The faceplate of a typical quad station outlet and all outlet configurations used.

- b) Outlet pathway elevation: shows the details of how the cables routing from the horizontal pathway to the outlet. Conduit size is at a minimum $\frac{3}{4}$ inch stubbed out to within six inches of the cable tray and bonded to the cable tray. In a typical cable tray, voice and data will be located on one side of the cable with the A/V cabling located on the opposite side.
- c) Grounding and bonding drawing: Shows the five major components for the grounding of the Network communications infrastructure throughout the building. The five components shown are the Bonding conductor, the Network communications main grounding bus bar, the Network communications grounding bus bar, the Network communications bonding backbone, Network communications bonding backbone interconnecting bonding conductor. All grounding and bonding shall meet the TIA/EIA – 607 standards and the NEC code.
- d) Campus Wide Drawings: Show all details for each individual campus wide access door interior and exterior. Drawings are not to scale. Refer to architectural and structural drawings for building construction and dimensions and to roof finish schedule on architectural drawings for the materials, finish and construction method of walls, floor and ceiling in order to insure proper rough in and installation of work.

Additional Standards and Codes

1. Work to conform with any city, State law, regulation, code, ordinance, and ruling or Fire Underwriters requirement applicable to this class of work.
2. Contractor will comply with the stricter requirement when a conflict occurs.
3. The following guidelines and standards will apply wherever applicable
 - o TIA-568-C Commercial Building Standards for Telecommunications
 - o TIA- 569-D Commercial Building standards for Pathways and Spaces
 - o TIA-606-B Administration (Labeling)
 - o TIA- 607-C Grounding and bonding of premises cable
 - o BICSI TDMM Telecommunications Distribution Methods Manual
 - o BICSI CO-OSP Customer-owned Outside Plant Design Manual
 - o ANSI/NECA/BICSI 568-2001

Renovations

The Voice, data, CATV, and AV must be coordinated through Network Communications. A certified contractor for the building solution-SYSTIMAX, NETCONNCET/Uniprise or Belden, does voice, data, CATV, and AV cabling that is in the renovation. Work under this section shall include providing all labor, materials, equipment, and services necessary for and reasonably incidental to the proper

completion of all Network communications work as shown on the drawings and herein specified. Work shall also include, but not be limited to the furnishings, unloading, handling, distribution, setting, supporting, and installation of all required components. The contractor will install as-bilts updating all changes in each TR and ER. Electronic copies of the as built will be provided to UNCW project management CAD department. Requirements for projects listed in the standards apply to all renovations involving voice, data, CATV, and AV.

Manholes and Duct banks

1. Seal all ducts at terminations or all conduit entry points with expandable reusable conduit plugs capable of withstanding 15-psi minimum hydro static pressure in manholes and buildings.
2. All duct banks will have a trace wire installed and a 1250-pound tensile test ½ “wide marking cord equivalent to NEPTCO Inc. or MULETAPE part # 1250P.
3. All conduits pulled as full as possible without damage to the cable.
4. All cables secured to the wall of the vault.
5. All cables clearly labeled using stamped aluminum.
6. The labeling for the cables will show destination, origination, cable size and pair count.
7. Cables labeled in all ER, MDF's, and IDF's.
8. Three 1 1/4-inch ID inner ducts placed in a minimum of one 4-inch conduit leading to every building.
9. The entrance conduit into each building, which contains the inner ducts, shall be equipped with a hole plug designed to seal around each individual inner duct.
10. Each inner duct sealed to prevent leakage into the building.
11. Manhole diagrams and duct bank diagrams shown on the Network communications drawings.
12. Each cable will have a slack loop in each manhole. The slack loop will be one full circle inside the manhole.
13. The distance between manholes should not exceed 450 feet.
14. Manhole lids will be equivalent to a U.S.F. FABRICATION, INC. APD 300.
15. Install conduits with gradual, sweeping elbows and offsets. Hard 90s are not acceptable.
16. Provide non-metallic cable rack on each wall in the manhole with a minimum of three arms each wall.
17. All duct banks inspected and approved prior to the placement of any concrete.

18. Duct bank poured with 3,000-psi concrete and encased all sides with a minimum of three inches.
19. After the duct line is completed, a standard flexible mandrel used for cleaning followed by a brush with stiff bristles. Mandrels shall be at least 12 inches long and have a diameter $\frac{1}{4}$ inch less than the inside diameter of the duct being cleaned.
20. A minimum of 2- 4-inch conduits schedule 40 PVC and is required for all Network communications duct banks. Schedule 80 PVC conduit is required for installation under roads and heavy traffic areas.

Joint Trench Required Separations

When a joint-trench method is used, the following vertical or horizontal separations for Network communications facilities and other facilities are used.

Vertical/horizontal separations

Adjacent Structure Minimum Separation

Power or other foreign conduit

- o 76 mm (3 in) of concrete, or
- o 101 mm (4 in) of masonry, or
- o 305 mm (12 in) of well-tamped earth.
- o Pipes (gas, oil, water)
- o 152 mm (6 inch) when crossing
- o 305 mm (12 in) when parallel.
- o Street railways 10 mm (3.3 ft.) below top rail.

NOTES: Place cable in rigid PVC conduit for a distance of 3 m (10 ft.) on either side of the pipeline crossing. If multiple pipelines exist, then extend conduit 3 m (10 ft.) from the outside pipes. Place rigid steel conduit for a minimum distance of 7.6 m (25 ft.) on either side of the center of the track (e.g., rails) crossing. If there are multiple tracks, the conduit should extend out 7.6 m (25 ft.) on either side of the center of the outside tracks.

Confined space Entry Procedures

The purpose of this safe work practice is to provide a procedure when working around an 'open' manhole or preparing to enter a manhole for routine maintenance or inspection. A manhole structure is a confined space that presents possible fall hazards

where there is a potential for toxic gases to be present. Therefore, ALL personnel assigned to enter Network Communications manholes shall follow the procedures in this work practice.

Required Safety Equipment and Procedures

All personnel working around open manholes and preparing to enter the manhole shall use the following safety equipment:

1. Approved gas detector (properly calibrated)
2. Fresh air blower;
3. Safety harness, rope, and tripod safety system; and
4. Approved hardhat.

All Network Communications manholes designed for entrance and inspection maintenance on a regular basis use the following procedures before entering the confined space:

1. Atmospheric Testing: Before allowing any personnel inside the confined space, test the space for all three atmospheric conditions, oxygen content, flammable or explosive gases and hydrogen sulfide.
 - a) Oxygen content must be at least 19.5% in the confined space, measured at all levels (bottom, middle, and top). The safe oxygen level is between 19.5% and 21%. Do not enter the confined space if the oxygen level is below 19.5% or above 21%. Due to the extreme danger of suffocation in confined spaces, constant and continuous oxygen monitoring is required throughout each work period. Oxygen content above 23% can cause explosions or vigorous burning of flammable materials, including hair or clothing.
 - b) After you have determined oxygen content, use the detector to measure flammability at all levels of the confined space (bottom, middle, and top). Flammability measured in terms of the Lower Flammable Limit (LFL) or Lower Explosive Limit (LEL). This is the smallest concentration of a combustible gas in air that will explode when it contacts a spark or open flame.
 - c) Finally, test the atmosphere for any toxic concentrations of vapors. Toxicity measured in terms of the Threshold Limit Value (TLV). Use the detector to measure toxicity at all levels of the confined space (bottom, middle, and top). Since toxic concentrations may be lighter or heavier than air, they can be present at the top or the bottom of the confined space. Note: The confined space tested at three levels for each

atmospheric condition. Each level tested for a minimum of 60 seconds. The gas detector itself lowered into the confined space atmosphere with a safety line or the detector with an aspirator pump. Consult the detector operating procedures manual if you have any operating questions.

2. Ventilation: A fresh air ventilation system shall be set up and in operation before and during all inspection and maintenance procedures.
3. After the air ventilation system has been in operation and the confined space has been tested and determined to be safe for entry, the operator shall be equipped with:
 - a) A safety harness and lifeline, attached to the tripod safety retrieval system.
 - b) An approved, properly calibrated gas detector that is in operation the entire time the employee is in the confined space. This is necessary due to the possibility of a rapid change in the confined space atmosphere.
 - c) An approved hard hat.
4. If permanent ladder steps are not in the confined space, use an aluminum ladder in good operating condition to enter the confined space. Any employee who descends into a man hole/sewer will have safety harness, rope, and tripod safety system attached to the employee.
5. At least one person stationed above ground for support purposes whenever a confined space is ready for entrance. .
6. Emergency Action Plan -- No person shall enter a confined space (manhole, to retrieve someone who is unconscious without having additional trained personnel above ground to assist. The person entering the confined space for rescue purposes must be equipped with the required rescue equipment and follow the specific rescue procedure.
7. A qualified person shall inspect all safety devices and instruct all involved employees on proper confined space safety procedures. All defective safety devices reported to the supervisor immediately. It shall be the supervisor's responsibility to insure that crews assigned to enter
8. Confined spaces have the required safety devices in their possession. The supervisor must assure the assigned employee has the required safety devices in their possession. The supervisor must assure the assigned employee trained to operate all safety equipment and understands all safety procedures.

General Manhole Safe Work Practices

1. Use caution when working around manholes.
2. Do not smoke, light open flames, or produce sparks in the immediate vicinity of open manholes.

3. Before removing manhole or entrance covers, test the atmosphere inside the manhole by using remote sampling probe or aspirators. If the lower explosive limit is above 10% inside the manhole, do not remove the cover.
4. Use picks, hooks to open manhole covers.
5. Lift manhole covers and heavy hatches with the legs. Never lift with the back muscles.
6. Lay removed manhole and heavy hatch covers flat on the ground several feet away from the opening.
7. With the manhole or entrance covers removal, the opening requires a railing, temporary cover, or other temporary barrier that will prevent an accidental fall through the opening and protect each employee working in the space from foreign objects entering the space.
8. Use barricades and/or warning devices to direct traffic around open manholes.
9. Follow Public Services Department directions for Confined Space Entry Program and all safety procedures before entering and during entry into any manhole.
10. Have at least two persons present before entering a manhole: One person to enter the manhole and one person in the clear to observe in the event of an emergency. One of the persons must be a "qualified person" as defined by the Public Services Department's Confined Space Entry Program This person bears the responsibility of completing the Confined Space Entry Permit. Never enter a manhole unattended.
11. Wear protective clothing and nonslip, non-sparking shoes in a manhole.
12. Test each individual manhole step carefully. Be sure to check ladder for overall structural soundness and ability to support weight before using.
13. Use ladders to access manholes whenever the structural soundness and support ability of the manhole steps/stairs are in question.
14. Take proper safety precautions when using ladders in a manhole.
15. Use a safety harness and life line when entering a vertical entry manhole, unless the lifeline creates an entanglement hazard.
16. Watch out for slippery footing in a manhole.
17. Do not hand carry tools and/or equipment while climbing up or down steps or a ladder into a manhole.
18. Raise or lower tools and/or equipment into a manhole using a rope, sling, or bucket.
19. Use only explosion-proof portable lighting and non-sparking tools in a manhole.
20. Avoid using electrical tools in or near water. Never stand in water when using electrical tools.
21. Constant ventilation is required when performing "hot-work" within a manhole, if the above safe works, practices is not accomplishable, or if there is a positive reading

Fire Stopping

1. This Section includes requirements for the furnishing and installing of fire rated wiring devices.
2. Furnish and install all fire rated wiring devices and associated hardware as shown on the Contract Drawings and as hereinafter specified.
3. All devices shall be heavy-duty specification grade with an intumescent insert material allowing for 0 to 100-percent visual fill of conductors.
4. The same manufacturer shall supply all furnished fire rated devices and associated hardware.
5. Fire rated wiring devices shall bear the UL Classification marking.
6. Device testing in accordance with ASTM E 814 (ANSI/UL1479).

Fire rated wiring devices

1. Cables passing through fire-rated floors or walls shall pass through fire-rated wiring devices which contain an intumescent insert material that adjusts automatically to cable additions or subtractions.
2. The device shall have an F Rating equal to the rating of the barrier in which the device installation is applied.
3. Wiring devices shall be capable of allowing a 0 to 100-percent visual fill of cables.
4. Wire devices shall be of a sufficient size to accommodate the quantity and size of data cables required.
5. Wire devices provided with steel wall plates for single or multiple devices allowing them to be joined.
6. Manufacturers' accepted for fire rated devices include Specified Technologies INC., Hilti, and 3M.

Installation

1. Wiring device installation is in locations where drawings indicate on the blue print, and are arranged singly or ganged at the height specified.
2. Install the devices in strict accordance with the approved shop drawings and the equipment manufacturer's recommendations.
3. Apply the factory supplied gasketing material prior to the installation of the wall plates.
4. Secure wall plates to devices per the equipment manufacturer's recommendations.
5. Buildings at UNC-W wiring is according to the established campus -wide wiring standards since the early 1990's. The fire safety considerations of the pathway systems shall comply with all applicable fire safety and electrical codes. In

general, the N.C. Department of Insurance determines the compliance of these systems with codes, and reserves the right to inspect and approve/disapprove their installation. If the pathway system is a metallic, enclosed system non-plenum cabling installation within unless otherwise noted. All wireway and conduit penetrations of rated walls and floors shall be fire stopped per applicable UL assembly. Plenum cable installed as required per the guidelines on an individual building basis. UNC-W adheres to the BICSI, NEC, and ANSI/TIA/EIA-569-A guidelines for fire stopping.

Cleaning

1. After the installation is complete contractor shall clean all systems.
2. Vacuum debris from system component, enclosures, junction boxes and pull boxes prior to testing and again prior to completion.
3. Thoroughly clean equipment of stains, paint spots, dirt and dust. Remove temporary labels not used for instruction or operation.

Codes, Permits, and Fees

1. Comply with all applicable laws, ordinances, rules, regulations, codes, or rulings of governmental units having jurisdiction as well as standards of the National Fire Protection association and serving utility requirements.
2. Obtain and pay for all permits, fees, inspections, utility connections and extensions and the like associated with work in each section of this division.
3. Comply with SCO for inspections as required.

End of Standards for Installation

SECTION 281300 - ACCESS CONTROL SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Building Access Control System per UNCW standards.

1.2 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specifications, Divisions 26, 27 and 28 Specification Section, apply to this Section.
- B. Section 26 08 00 - Commissioning of Electrical

1.3 REFERENCES

- A. NECA (National Electrical Contractors Association) "Standard of Installation."
- B. NFPA 70 National Electrical Code.
- C. STS-1000 Telecommunications Wiring Guidelines.
- D. UNCW-ITS "Infrastructure Standards For Installation" Rev. 06/01/2019.
- E. UNCW Physical Security and Access: "Standards And Procedures Security Room Construction/Renovations", Rev 06/2017
- F. UNCW Physical Security and Access: "Standards and Procedures Installation of Access Control Equipment". Rev. 12/05/18
- G. TIA/EIA-568: Telecommunications Industry Association of the Electronic Industries Alliance (EIA)

1.4 SUBMITTALS:

- A. Product Data for system components
- B. Equipment connection details and electrical power requirements.
- C. Typical device connection details.
- D. System single line diagram including all devices and components.
- E. Terminal schedules

1.5 PROJECT RECORD DOCUMENTS

- A. Record actual locations of Products; indicate actual branch circuit arrangement.

1.6 OPERATION AND MAINTENANCE DATA

- A. Maintenance Data: Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with NECA Standard of Installation.
- B. Maintain one copy of each document on site.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Installer: Company certified and in good standing with the manufacturer for the installation, programming, configuring of the products specified in this section with minimum three years documented experience.

1.9 REGULATORY REQUIREMENTS

- A. Furnish products listed and classified by third party agencies accredited by the NCBCC to label electrical and mechanical equipment, as suitable for purpose specified and indicated, where such listing exists.
- B. Conform to requirements of NFPA 70.
- C. Conform to requirements of STS-1000.

1.10 PROJECT REQUIREMENTS

- A. Comply with applicable requirements of Appendix A “Standards and Procedures Security Room Construction/Renovations, Rev 062017” Authored by UNCW Physical Security and Access for a fully functional system.
- B. Comply with the applicable requirements of UNCW-ITS “Infrastructure Standards For Installation” Rev. 06/01/2019.
- C. Comply with the applicable requirements of Appendix B “Standards and Procedures Installation of Access Control Equipment”. Rev. 12/05/18.

PART 2 - PRODUCTS

2.1 ACCESS CONTROL COMPONENTS

- A. See Equipment and device schedule on drawings.
- B. Software and licensing needed for system operation and configuration for a minimum of one workstation is included.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Demonstrate specified system functions to the owner.

3.2 DOCUMENTATION

- A. Provide complete system documentation

3.3 TRAINING

- A. Provide owner system training for no less than 4 hours to cover operation, configuration, interfacing with the system and any detailed questions of the trainees.
- B. Include video recording of owner system training.

3.4 WARRANTY

- A. Refer to warranty requirements per the project manual.

END OF SECTION 281300

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APPENDIX A

Standards and Procedures Security Room
Construction/Renovations

University of North Carolina Wilmington, Rev 06/2017



Standards and Procedures
Security Room Construction/Renovations
At
University of North Carolina Wilmington

Rev 062017
Provided by UNCW Physical Security and Access

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Overview

This document defines the requirements of the security rooms by Physical Security and Access.

The purpose of this documentation is to ensure the security room meets all the requirements set forth by Physical Security and Access.

Cable Installation

All cabling shall be installed in a manner that will protect the cable from damage during installation, facilitate cable management and identification and provide a neat and groomed appearance. The horizontal cables shall be bundled in the Access Control Security room ladder tray, using **Velcro** cable ties. Plastic ty-wraps are not allowed in the Access Control Security room.

Security Room

The security room will be used for access control/CCTV equipment only. For security reasons, this space cannot be shared by other building services, such as Housekeeping, HVAC, Electrical, etc.

1. The swing of the security room doors must always open into the hallway.
2. All Communications Rooms shall have direct access to the hallway or other such corridor.
3. Security room should be provided a minimum of one (1) standard drop for each interior wall mounted 82 inches AFF to the TOP of the outlet.
4. Security rooms should not contain any type of sinks or be used as storage for Custodial or any other such supplies.
5. Security rooms should not be used for storage of any kind (i.e. Books, Furniture, A/C Filters, Light Bulbs, AV Equip. etc....).
6. Floors in security rooms should be sealed concrete or tile. Carpeted floors are unacceptable due to the associated static electricity they create, posing a threat of damage to sensitive access control and CCTV security electronics.
7. A minimum space of 10' X 10' X 8'H is required for all Security Rooms. Square foot size: 10,000 sq ft 10'x11', 8,000 sq ft 9'x10' and 5,000 sq ft 7'x10'.
8. Security room walls shall be covered in ¾" non-fire rated plywood horizontally, be void free and finished on one side with each board mounted 4 inches AFF (Above Finished Floor) the total perimeter of the room. The non-fire rated plywood shall be painted with at least two (2) coats of fire resistant white paint on all six (6) sides. The final paint finish shall be clear of footprints, markings, etc. and be a smooth finished product, NO exceptions.

9. All Security rooms shall be equipped with a solid copper grounding bus bar $\frac{1}{4}$ inches thick by 4 inches high with compression fittings and standoff brackets with insulators on the security room backboard.
10. Bus bars shall be connected by a backbone of insulated, solid copper (minimum #6 awg, with 3/0 recommended). This backbone is connected to a main grounding bus bar in the electrical entrance facility that is tied back to the building's grounding system. This point should be at an electric panel per NEC 2005 standards. Chatsworth grounding bar 10622-010 is in use on the campus. The grounding bar will be mounted above the horizontal cable tray in the security room.
11. All cables shall be routed into the security rooms through overhead ladder racking to include a bridge to the equipment rack. The ladder racking will be 18" minimum width. The racks and ladder racking will be properly anchored to the floor and grounded.
12. Lighting, HVAC, Perimeters and dust design considerations tia/eia-569-A shall also be followed. Security rooms on a limited basis may be able to have shared low voltage space in the telecommunications room.
13. Fire alarm panels are not to be mounted in the security room.
14. All electrical outlets shall be mounted 15 inches AFF to the TOP of the outlet.
15. All electrical outlets shall be on Emergency Generator circuits. If the building does not have an Emergency Generator the circuits will be installed for ease of switchover if an Emergency Generator is installed.
16. No electrical conduits, refrigerant pipes, water pipes, HVAC ducting or piping or any type of wiring for non-related security devices maybe installed thru the overhead ceiling, walls or the flooring.
17. Dedicated duplex 20 amp 110vac outlets on separate circuits are required. Convenience outlets will be mounted at 3 ft. intervals around the perimeter.
18. Security rooms shall not include false ceilings. All surfaces shall be treated to reduce dust. Walls and ceiling shall be painted white to improve visibility.
19. HVAC: 24 hours/day, 365 days a year, 64 degrees to 75 degrees Fahrenheit, 30 to 55% humidity, positive pressure. The security room shall not have any type of heat supplied due to temperature interference with security components.
20. Lighting: Typically, 8.5 ft. high providing 50 ft candles @ 3 ft. above floor.
21. Dust: less than 100 micrograms /cubic meter/24-hour period.
22. Each security room shall include one (1) 7' x 19" aluminum equipment rack, to include a patch panel that matches the same provided for the telecommunications closet. Each rack will also house a minimum of one (1) rack-mounted surge suppressor or UPS. In addition, a fiber connection from the telecommunications room shall be provided.

23. Security room rack should include a 24-port network switch provided by Networking/Communications.
24. The security room equipment rack shall include 6-strand single mode fiber optic with lucid connectors. It shall also include one (1) 25 pair power sum.
25. Security rooms shall also include one (1) Lenel iClass keypad card reader per Access Control Door Standards.

Inspection

Damages

The Contractor shall be held responsible for any and all damages to portions of the building caused by it, its employees or subcontractors; including but not limited to:

- All Damage to any portion of the building caused by the movement of tools, materials or equipment.
- All Damage to any component of the construction of spaces “turned over” to the Contractor.
- All Damage to the electrical distribution system and/or other space “turned over” to the Contractor.
- All Damage to the electrical, mechanical and/or life safety or other systems caused by inappropriate operation or connections made by the Contractor or other actions of Contractor.

Other damage to the materials, tools and/or equipment of UNCW, its consultants, General Contractor, subcontractors, Architect, other contractors, agents and leases.

General Requirements

1. Work under this section shall include providing all labor, materials, equipment, and services necessary for and reasonably incidental to the proper completion of all security room work as shown on the drawings and herein specified. Work shall also include, but not be limited to the furnishings, unloading, handling, distribution, setting, supporting, and installation of all required components.
2. Additional standards and codes:
 - a. Work shall be installed to conform with any city, State law, regulation, code, ordinance, ruling or Fire Underwriters requirement applicable to this class of work.
 - b. Contractor shall comply with the stricter requirement when a conflict occurs.

Firestopping

1. This Section includes requirements for the furnishing and installing of fire rated wiring devices.
2. Furnish and install all fire rated wiring devices and associated hardware as shown on the Contract Drawings and as hereinafter specified.
3. All devices shall be heavy-duty specification grade with an intumescent insert material allowing for 0 to 100-percent visual fill of conductors.
4. The same manufacturer shall supply all furnished fire rated devices and associated hardware.

Cleaning

1. After installations is complete contractor shall clean all systems.
2. Vacuum debris from system component, enclosures, junction boxes and pull boxes prior to testing and again prior to completion.
3. Thoroughly clean equipment of stains, paint spots, dirt and dust. Remove temporary labels not used for instruction or operation.

Codes, Permits, and Fees

1. Comply with all applicable laws, ordinances, rules, regulations, codes, or rulings of governmental units having jurisdiction as well as standards of the National Fire Protection association and serving utility requirements.
2. Obtain and pay for all permits, fees, inspections, utility connections and extensions and the like associated with work in each section of this division.
3. Comply with SCO for inspections as required.

Revision History

Rev 062017 – Updated entry 16 on page 4 to include the word “walls.” Added a Revision history page.

UNCW Physical Security and Access

Contact Information:
Accessmgmt@uncw.edu
(910)962-3564

Please contact the UNCW Physical Security and Access Manager with any questions or concerns pertaining to this document.

APPENDIX B

Standards and Procedures Installation
of Access Control Equipment

University of North Carolina Wilmington, Rev. 12/05/18



Standards and Procedures

Installation of Access Control Equipment At University of North Carolina at Wilmington

UNCW

REV 120518

Provided by UNCW Physical Security and Access

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OVERVIEW

The purpose of this document is to define the standards and procedures for the installation of access control equipment, electronic locks, cables, wire and all ancillary equipment on the campus of the University of North Carolina at Wilmington (UNCW) and all properties owned or leased by the university.

The integrity of all equipment, cabling and proper installation is essential to the University's commitment to providing a safe and secure environment for students, faculty, staff and visitors of UNCW. These standards and procedures shall be reviewed and updated regularly to ensure they are up-to-date and accurate.

All standards and procedures in this document shall be compliant with all relevant laws or directives set forth by the Federal Government, the State of North Carolina, The University of North Carolina System and the University of North Carolina at Wilmington.

UNCW Physical Security and Access reserves the right to hire an outside contractor to perform electronic control equipment installation upon the review of the scope of the job and the timeframe necessary to complete the project. In addition, the overall costs associated with the equipment installation (i.e. labor) shall bear weight into the final decision of using contracted services versus UNCW Physical Security and Access.

OUTLINE

1. All Access Control Installations shall conform to the Americans with Disabilities Act and any other applicable local, state or federal regulations and must adhere to state and local fire code for life safety.
2. Cables and wiring shall conform to the standards set by UNCW ITS-NetCom and the particular solution installed in the building.
3. All Access Control door hardware shall be approved for use at UNCW. Any necessary changes will require approval from UNCW Physical Security and Access.
4. All equipment must be compatible with the Lenel OnGuard Access Control system.
5. All new and retro construction requiring Access Control shall use wired control devices. No wireless devices shall be installed on any door without prior authorization from UNCW Physical Security and Access
6. All Access Control equipment must come to the UNCW Physical Security and Access office prior to installation.

UNCW Door Hardware Standards

1. Door locksets shall be either Best electric mortise lock with request to exit and internal deadbolt switch with indicator (Included in the approved parts list of this document) or Von Duprin panic device with low current request to exit switch and approved by a UNCW Locksmith and UNCW Physical Security and Access.
2. Interior doors shall conform to a mortise lockset. Exterior doors shall conform to a panic device lockset. Electric strikes and Magnetic locks are NOT acceptable. All other configurations require approval from UNCW Locksmith and UNCW Physical Security and Access.
3. For proposed wireless solutions, please see page 9.
4. Card access equipment **MUST** be provided by an approved UNCW Certified Lenel VAR and the VAR must be approved by UNCW Physical Security and Access. Installation and wiring of all access control equipment **MUST** be performed by Lenel Certified technicians. Physical Security and Access **MUST** approve any equipment changes.
5. Power supplies for all electric locksets shall be Von Duprin model PS914-4RL. Power Supplies must be mounted in a secure space and shall NOT be installed above doors or ceilings. One PS914-4RL can control two (2) RIM devices. One PS 914-4RL can control up to four (4) electronic mortise locks or four (4) QEL devices.
6. Hinges for all card system doors shall be Hager hinge model BB1199 or BB1191 ETW-8 US 32D or Select continuous hinges with service panel and eight (8) through wires. Prep work of doorframe will be the responsibility of General Contractor. At grout filled frames, a mortar box (Example: Hager #430), shall be furnished for each electrified hinge and shall be furnished to the Hollow Metal Frame supplier for installation on the frame prior to the frame being shipped to the project site.
7. The preferred first choice of door monitoring shall be a magnetic ¾-inch diameter door position switch, such as a GE Security 1078C series or equivalent. If there is no provision for installing a magnetic door position switch, a plunger style, such as WINN Security BR-1032 or equivalent shall be allowed. On double doors where each leaf has a DPS, the devices shall be wired in series. Both sensors shall report alarms to the system as a single alarm point.
8. Doors with a 3-hinge configuration shall have the middle hinge being the electrified hinge. Doors with a 4-hinge configuration shall have the lower middle hinge being the electrified hinge. Hinge height should be 39" to 40" to top of hinge. Panic device electrified hinges shall be as close to even with the panic device as allowable for proper wire length from electrified hinge.
9. Interior doors specified with card access, and furnished with an electrified mortise lock shall contain a temperature control module built into the lockset, or shall have a temperature control module provided with the lockset.
10. Doors requiring a panic device shall include QEL electric latch retraction and low current request to exit switch.
11. ADA openers require a control cable, as specified in the door control section of this document, run from ADA opener to lock power supply, to be installed by the Contractor.
12. All Access Control Doors **MUST** include a door closer that conforms to all UNCW door hardware standards.

UNCW HID iClass Reader Requirements

The UNCW campus uses a multi-tech HID One Card which includes HID iClass technology as well as NXP MIFARE technology. The HID iClass chip in the One Card is used to interact with the campus Lenel Access Control System. The MIFARE chip included in the card is used for UNCW Point of Sale Services. Standard HID iClass SE multiclass readers are capable of reading both technologies included in the UNCW One Card. The use of standard readers will result in failures when cardholders attempt to use their cards at authorized reader locations. For this reason, UNCW requires the use of specific HID iClass readers that are programmed to only recognize HID iClass technology. Below is a list of authorized HID iClass reader models and part numbers.

1. RK-40 HID iClass Keypad Reader with terminal connection – Part Number: 921NTNTEK0004L ***this reader is the standard to be used for all installations unless a change has been approved by the UNCW Physical Security and Access Manager.**
2. RK-40 HID iClass Keypad Reader with pigtail connection – Part Number 921NTNNEK0004L
3. R-40 HID iClass Reader with terminal connection – Part Number 920NTNTEK0003V
4. R-40 HID iClass Reader with pigtail connection – Part Number 920NTNNEK0003V
5. R-10 HID iClass Mullion Mount Reader with terminal connection – Part Number 900NTNTEK0004F
6. R-10 HID iClass Mullion Mount Reader with pigtail connection – Part Number 900NTNNEK0004F

LENEL Network Communications

A network data drop is required at the main Lenel communications panel (UNCW will designate a network port). Additional Lenel door access panels in other areas of the building require a 2 pair 22 gauge stranded cable to the main Lenel Communications panel.

Door Control Cabling

From Telecom Closet to Junction box: A (1) inch conduit is required from the control board out to a junction box in the ceiling above the door to encase all the following wires:

- **Lock Power:** Refer to Chart

Lock	AWG	Max Distance	Example
EL98/99NL	12	180 Feet	Belden 8477
QEL98/99NL	12	300 Feet	Belden 8477
Mortise/Strike	16	300 Feet	Belden 8471

- **Door Position and Request to Exit Cables:**

In single door application: A (1) pair 22-gauge stranded cable is used for RX connections. This cable shall be run to the center door hinge area of the door using ¾-inch flex conduit from the junction box and shall be terminated with an electric pass through hinge. A (1) pair 22-gauge stranded cable for the DPS shall be run in ¾ inch flex conduit from the junction box to top of door frame, no farther than one foot from latch side of door.

In double door application: The right hand door from the outside or reader side shall require all specifications of single door wiring. The additional door shall require (1) pair 22-gauge stranded cable for the DPS and shall be run in ¾ inch flex conduit from the junction box to top of door frame, no farther than one foot from latch side of door, and a second (1) pair 22-gauge stranded cable will be required for RX connections in a ¾ inch flex conduit from the junction box to the center hinge of the door.

- **Card Reader Wire:**

Pulled to single gang box at the card reader location: A (3) pair 22-gauge shielded stranded gauge wire shall be used for the door reader and pulled through a ¾ inch flex conduit from the junction box to a single gang junction box in the area designated for mounting of the card reader.

- **Handicap Door Controller Cable:**

Pulled to Handicap Door Controller: If a handicap door opener is required, a Cat 6 cable or 22/6 stranded shielded wire shall be pulled from the access control board to the control board of the handicap opener. This shall pass through the junction box and be in a ¾ inch flex conduit to the handicap door opener control board. All terminations of this wire shall be performed by the installation contractor. Termination and installation of opener and paddles is the responsibility of the GC.

Responsibilities

UNCW

1. UNCW Physical Security and Access department shall oversee installation and maintain all Lenel and access control equipment as well as provide the department requesting Access Control with an estimate for the necessary Lenel and ancillary equipment.
2. UNCW shall provide all network equipment to include network switches. The UNCW Network Data Analyst shall assign any necessary switches, ports and IP addresses.
3. UNCW Physical Security and Access shall be responsible for setting up Status Levels, Door Schedules and assigning Access as appropriate.
4. The UNCW Network Infrastructure Analyst shall monitor the installation of wires and cables to ensure that all UNCW ITS-NetCom Department standards are satisfied.
5. The UNCW Project Manager shall provide “As Built” drawings to the UNCW Physical Security and Access department where applicable.

Contractors

1. The contractor shall ensure that they are operating in compliance with any North Carolina General Statutes that may be applicable to performing any part of their duties.
2. The contractor shall provide and pull all required low voltage power and data cabling as well as ground wire as required.
3. The contractor shall provide power supplies; install all conduits and any other necessary door hardware or other materials to complete the installation. All equipment shall be in accordance with UNCW Physical Security and Access Standards and UNCW standards for door hardware. Any substitutions must be submitted to the UNCW Physical Security and Access manager for approval or the Physical Plant as appropriate.
4. The contractor shall provide materials and electricians if additional 120 VAC services are required.
5. The contractor shall label all cables and wires to allow for UNCW Physical Security and Access personnel to identify the location and purpose of each cable or wire.
6. The contractor shall install all panels, power supplies and other electronic equipment associated with the Access Control System. The termination of all wires and cables shall be in accordance with the guidelines set forth in this document.

Standards for Termination of wires and cables in Lenel Panel, Lock Power Supplies, Readers, Hinges and Door Hardware

1. Splicing of wires and conductors shall **NOT** be permitted.
2. All lock power connections shall be made using solder and heat shrink tubing. Wire nuts and other such connectors shall not be permitted.
3. Connections at transfer hinges, readers, and other equipment other than lock power shall be made using 3M Scotchlok UY2 connectors or similar connectors in lieu of solder and heat shrink tubing, Wire nuts are not permitted.
4. Spare conductors in cables shall not be eliminated. Cut the spare conductors to the same length as the conductors in use and wrap them around the cable jacket for future use.
5. Cable, wires and conductors shall be cut so that a reasonable length is left for future service.
6. There shall be proper cable management of all wires, cables and cords in the Security room, in Lenel panels and lock power supplies. Cable grommets shall be used to route wires and cables into panels, cabinets and junction boxes.
7. The wiring color codes provided in this document shall be used when possible. UNCW Physical Security and Access must approve changes.
8. All Power Cords in the Security Room shall be plugged into a surge protector power strip.
9. All panels and power supplies shall be labeled so that service technicians can easily identify the location of readers, lock power, inputs and outputs.
10. Power tools shall **NOT** be used when installing soft, metal screws in door hardware.

UNCW Wireless Access Control Standards

Introduction

Wired readers and locks are the standard for Access Control on the campus of UNCW. The use of wireless equipment **MUST** be approved by UNCW Physical Security and Access. Wireless equipment shall not be used for external doors. Installation of wireless equipment **MUST** conform to the standards set forth in this document.

Standards

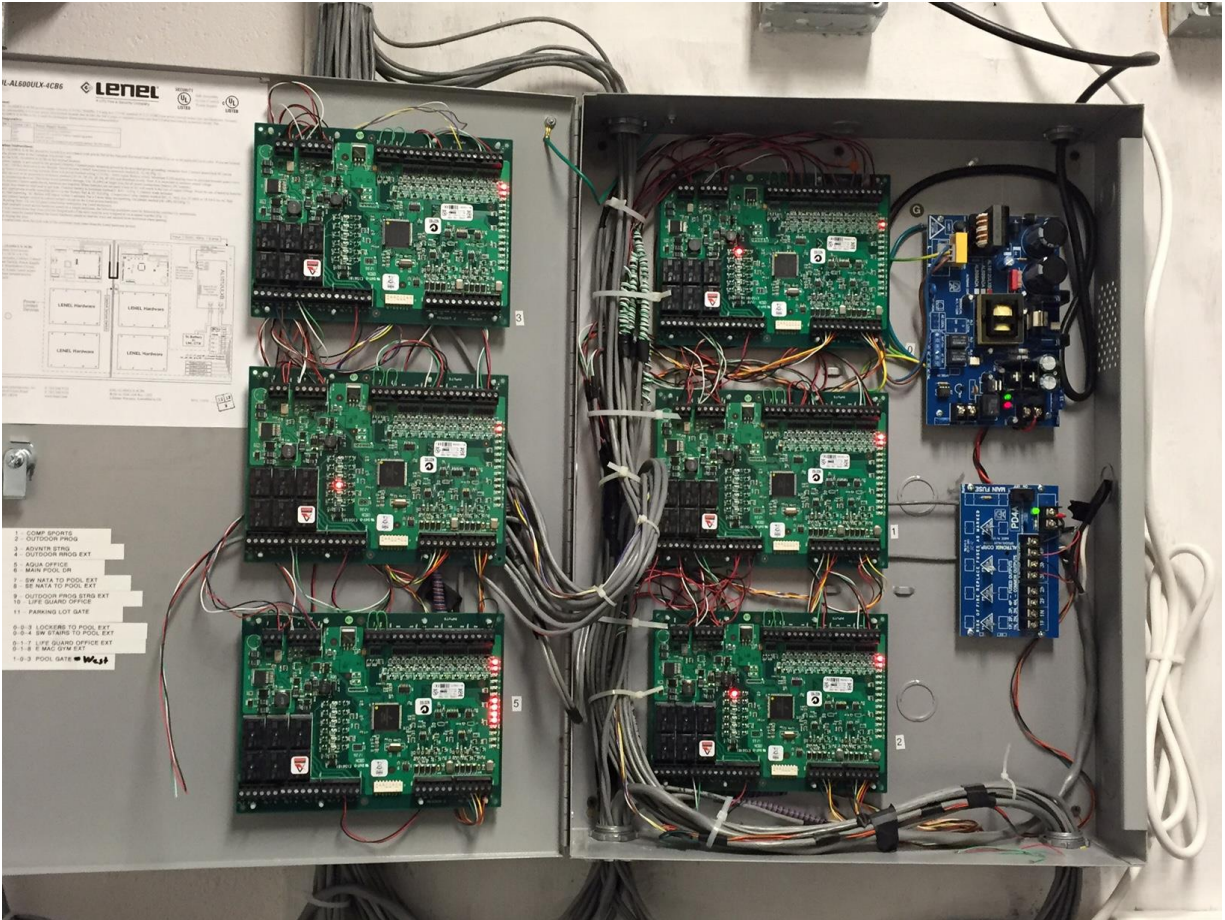
1. All access control equipment installed on the campus of UNCW **MUST** be compatible with Lenel OnGuard software and hardware. UNCW Physical Security and Access has approved the Allegion AD400 wireless electronic lock for limited use on campus. The AD400 lock shall conform to the following:
 - The appropriate lock type (mortise, cylindrical, RIM) shall meet all UNCW standards for door hardware.
 - The lock shall include a Schlage SIK2 reader designed for use with the HID iClass format and include a keypad.
 - The lock shall include the “Privacy” Function (40).
 - The lock trim color shall be grey with the 626 satin finish and Sparta lever.
 - The lever cylinder type shall conform to the UNCW standard. The appropriate Allegion part number code is “BD.”
2. PIM (Panel Interface Modules) **MUST** be purchased from an approved Lenel VAR and the firmware flashed for use with Lenel OnGuard software and hardware. The approved PIM types are as follows:
 - PIM400-485 – PIM is used for RS-485 communications and will only function with the LNL-3300 ISC when multiple PIMs are required or the LNL-2210 ISC when a single PIM is necessary. The PIM must be attached to a dedicated communication port on the ISC (Integrated System Controller) as they will not function properly in a circuit that includes wired Reader Interface Modules such as the LNL-1320.
 - PIM400-1501 – PIM includes an onboard LNL-2210 ISC and communicates directly with the network. This PIM will support a maximum of 16 AD400 wireless locks.
 - UNCW Physical Security and Access **MUST** be consulted as to which PIM solution shall be employed to ensure maximum functionality and expandability of the wireless system.
3. A wireless signal survey **MUST** be performed to accurately determine the location of all PIMs to ensure proper communication to all associated wireless locks. UNCW Physical Security **MUST** perform the survey. Contractors may schedule to be present if desired.

Example Photos of Installed Panels and Power Supplies

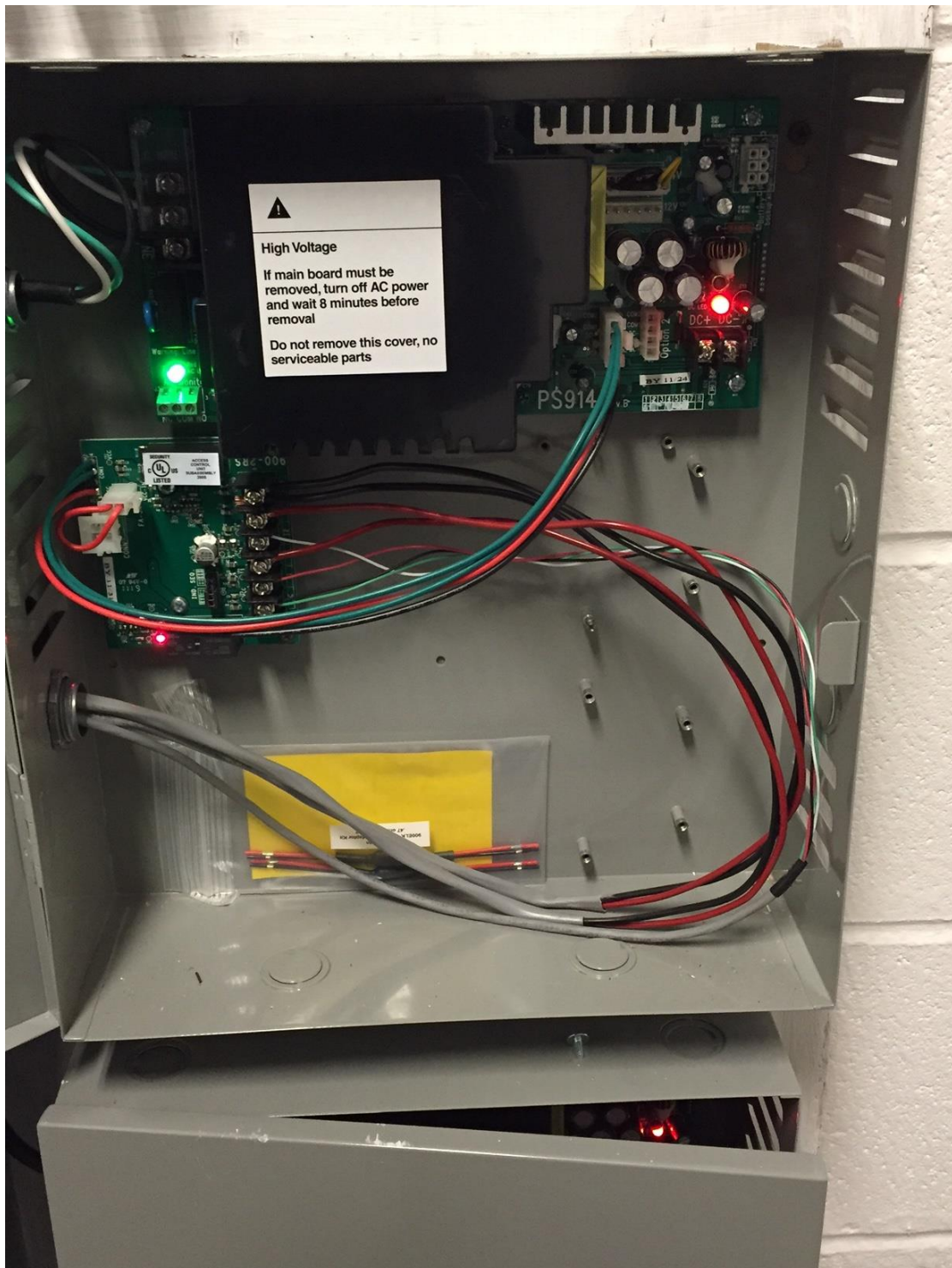
Panel with Power Supply



Inside Lenel Panel

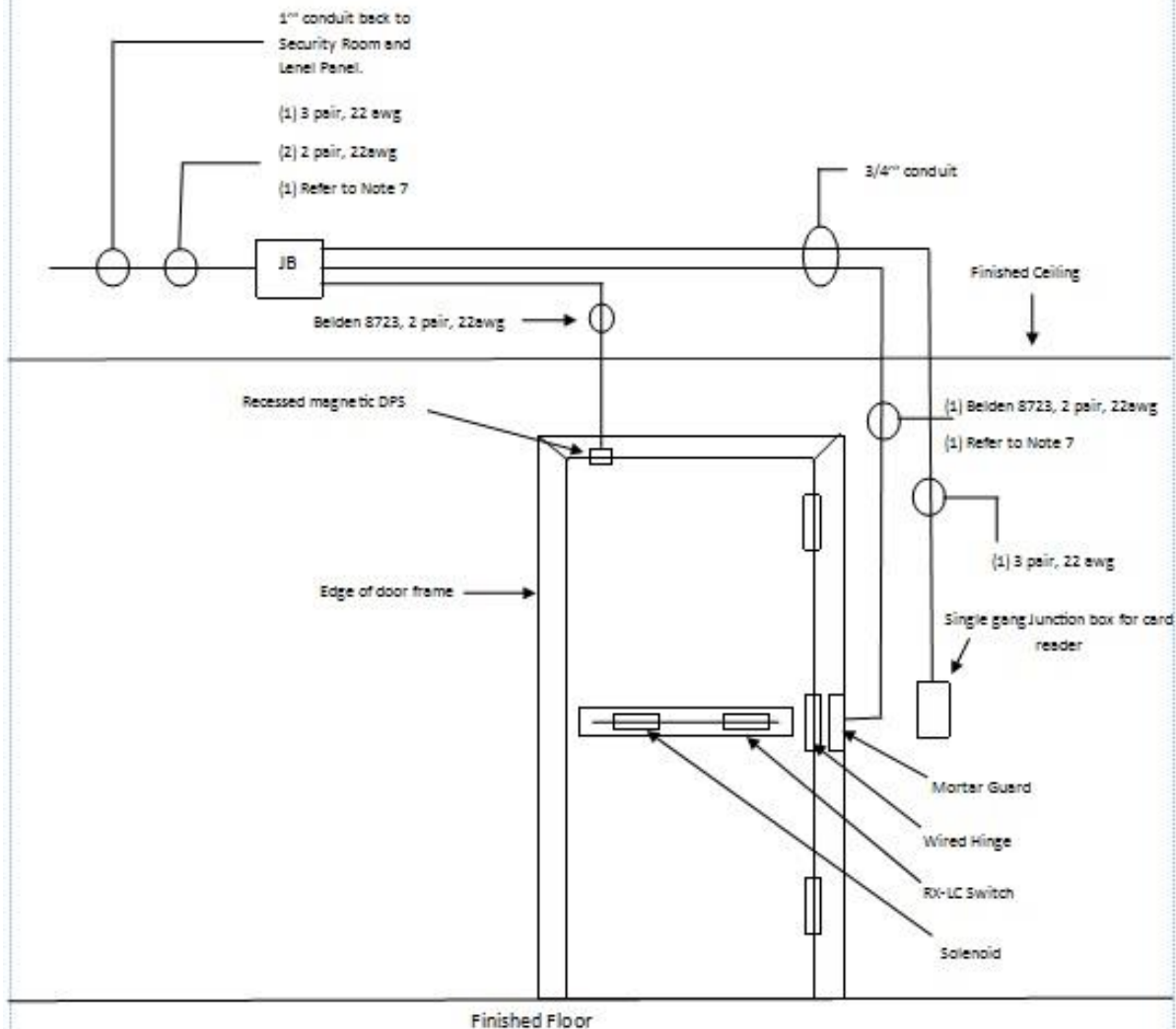


Inside Power Supply Panel



Typical Installation for a Single Door with a Magnet DPS

Typical Access Control Installation for a Single Door with Magnet DPS



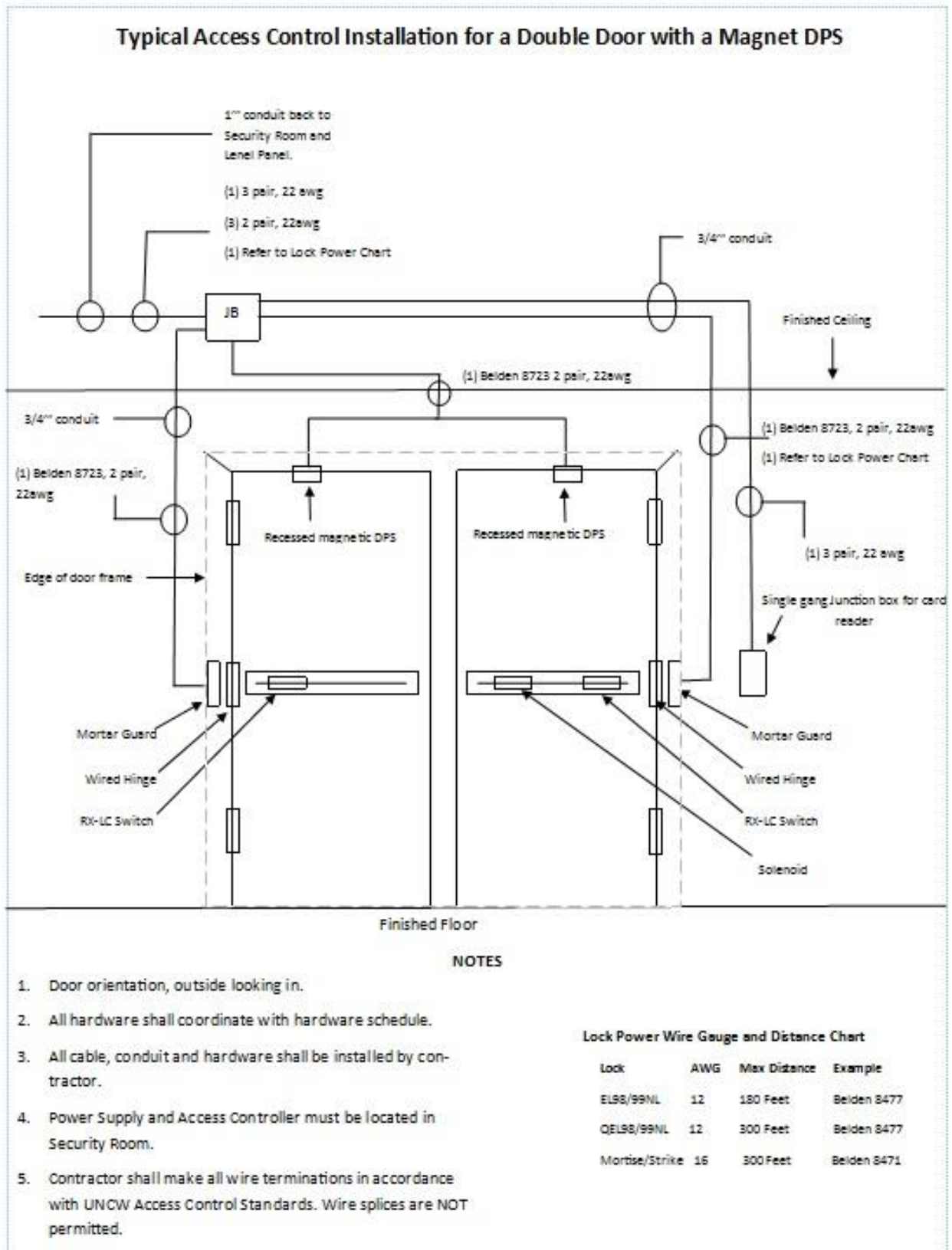
NOTES

1. Door orientation, outside looking in.
2. (JB) Cabling Junction Box
3. All hardware shall coordinate with hardware schedule.
4. All cable, conduit and hardware shall be installed by contractor.
5. Power Supply and Access Controller must be located in Security Room.
6. Contractor shall make all wire terminations in accordance with UNCW Access Control Standards. Wire splices are NOT permitted.

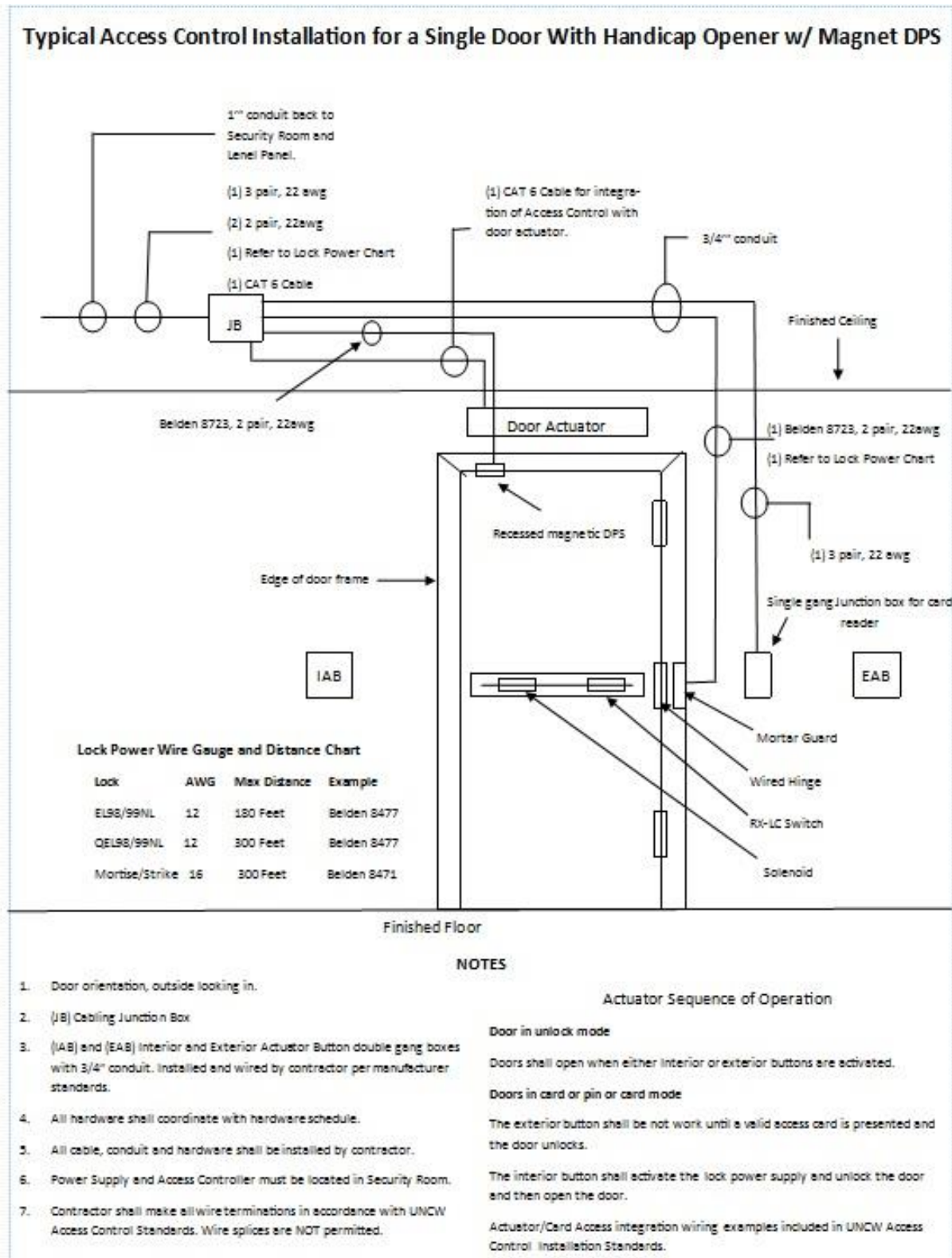
7. Lock Power Wire Gauge and Distance Chart

Lock	AWG	Max Distance	Example
EL98/99NL	12	180 Feet	Belden 8477
QEL98/99NL	12	300 Feet	Belden 8477
Mortise/Strike	16	300 Feet	Belden 8471

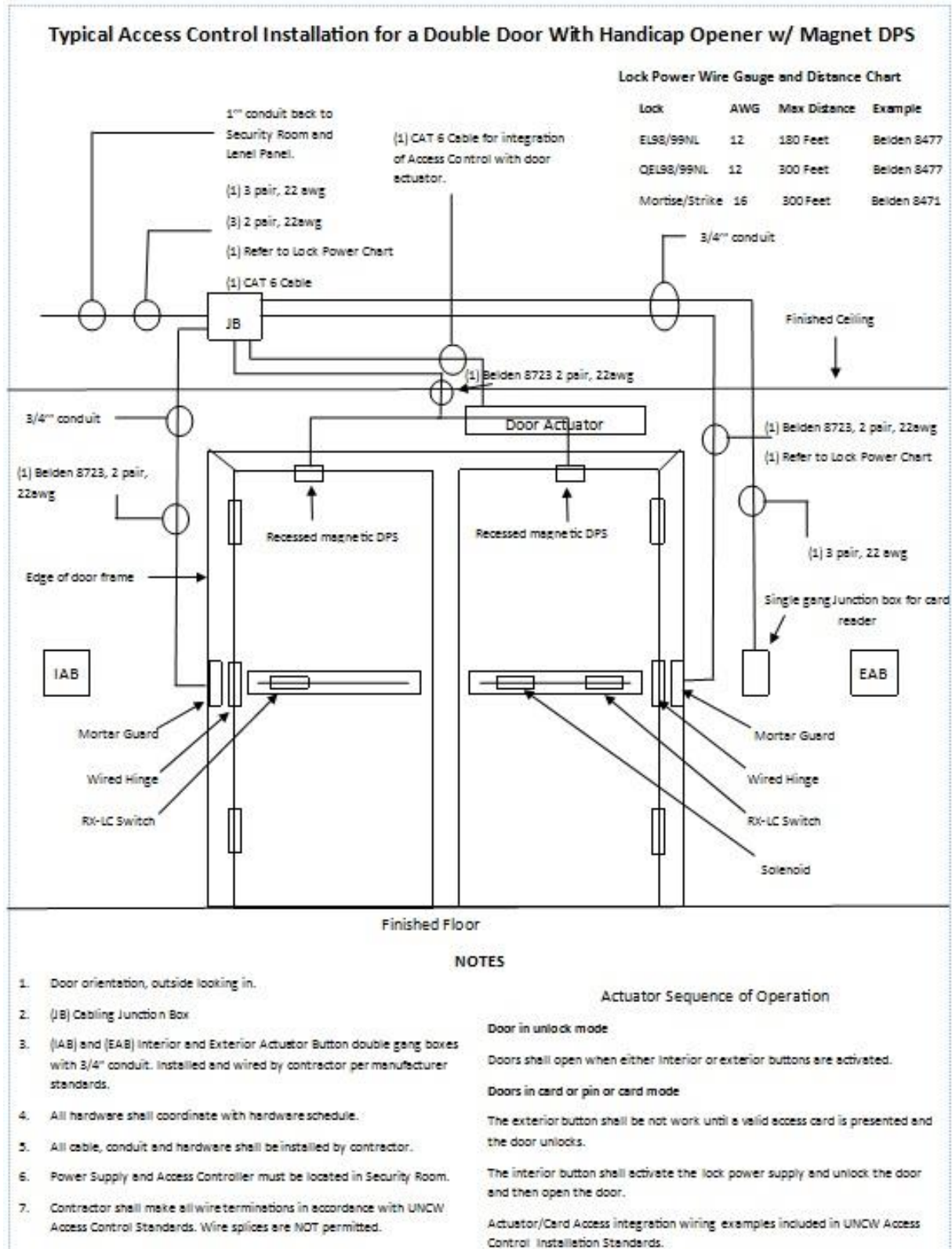
Typical Installation for a Double Door with a Magnet DPS



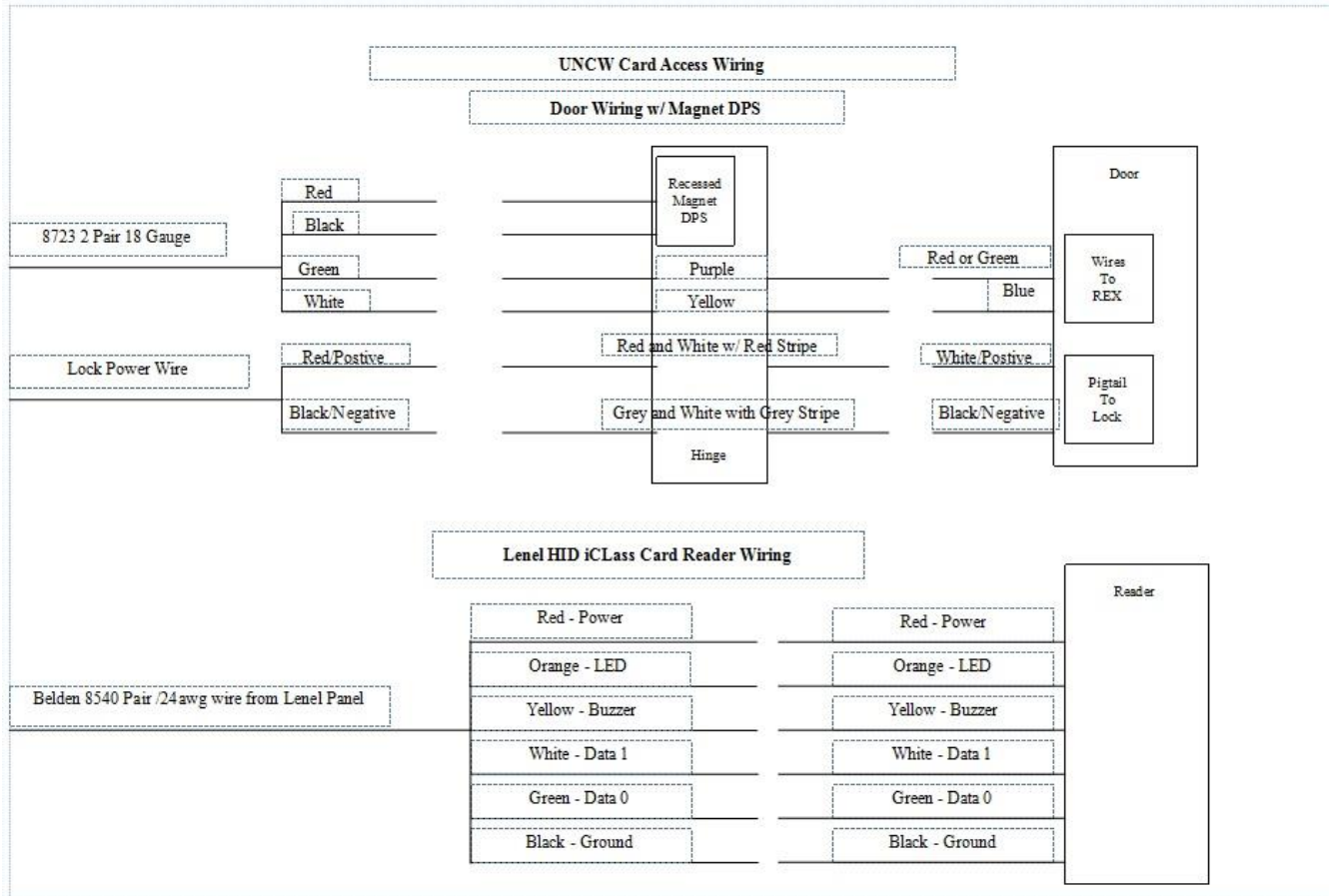
Typical Installation for a Single Door with Handicap Opener w/ Magnet DPS



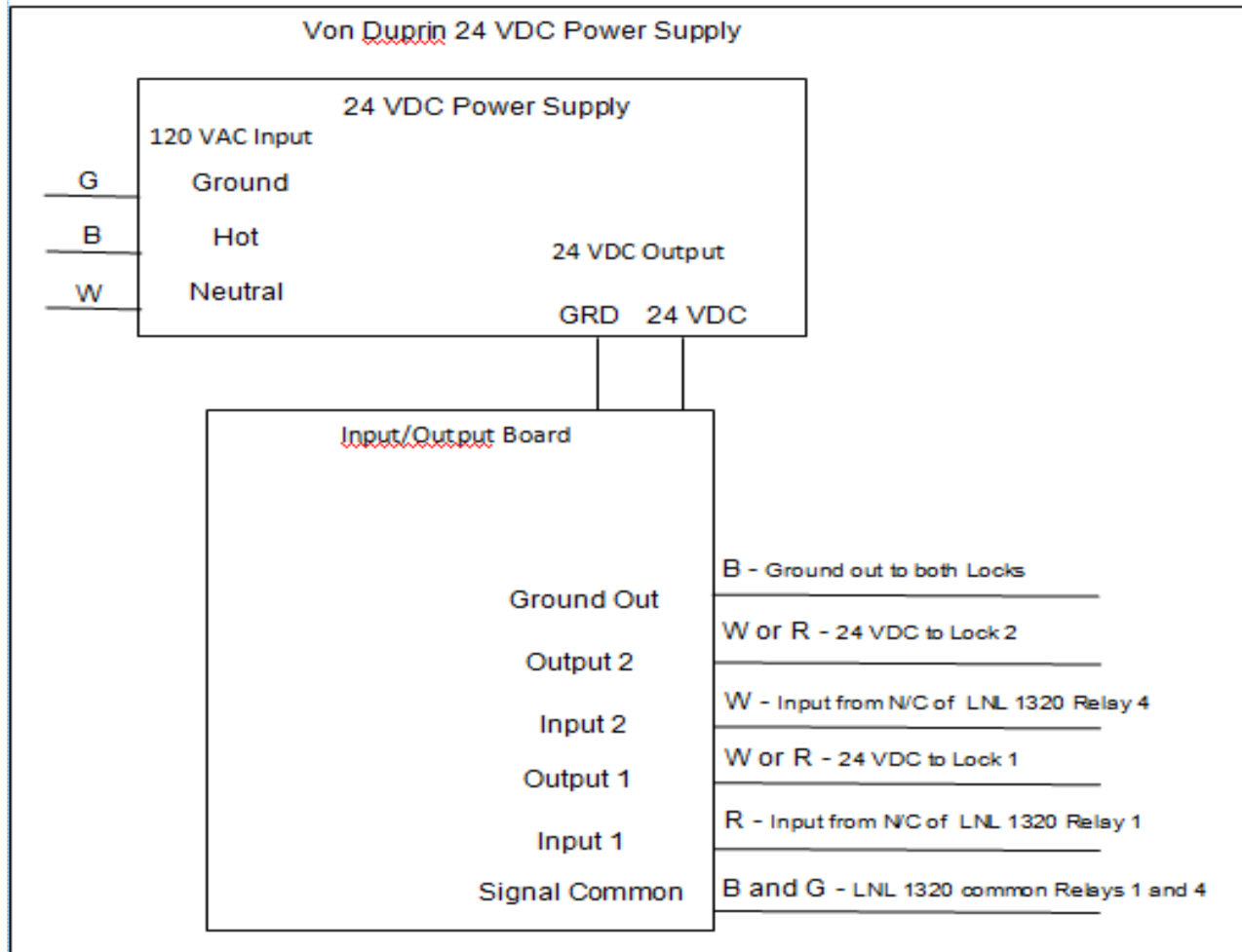
Typical Installation for a Double Door with Handicap Opener w/ Magnet DPS



UNCW Card Access Door Wiring



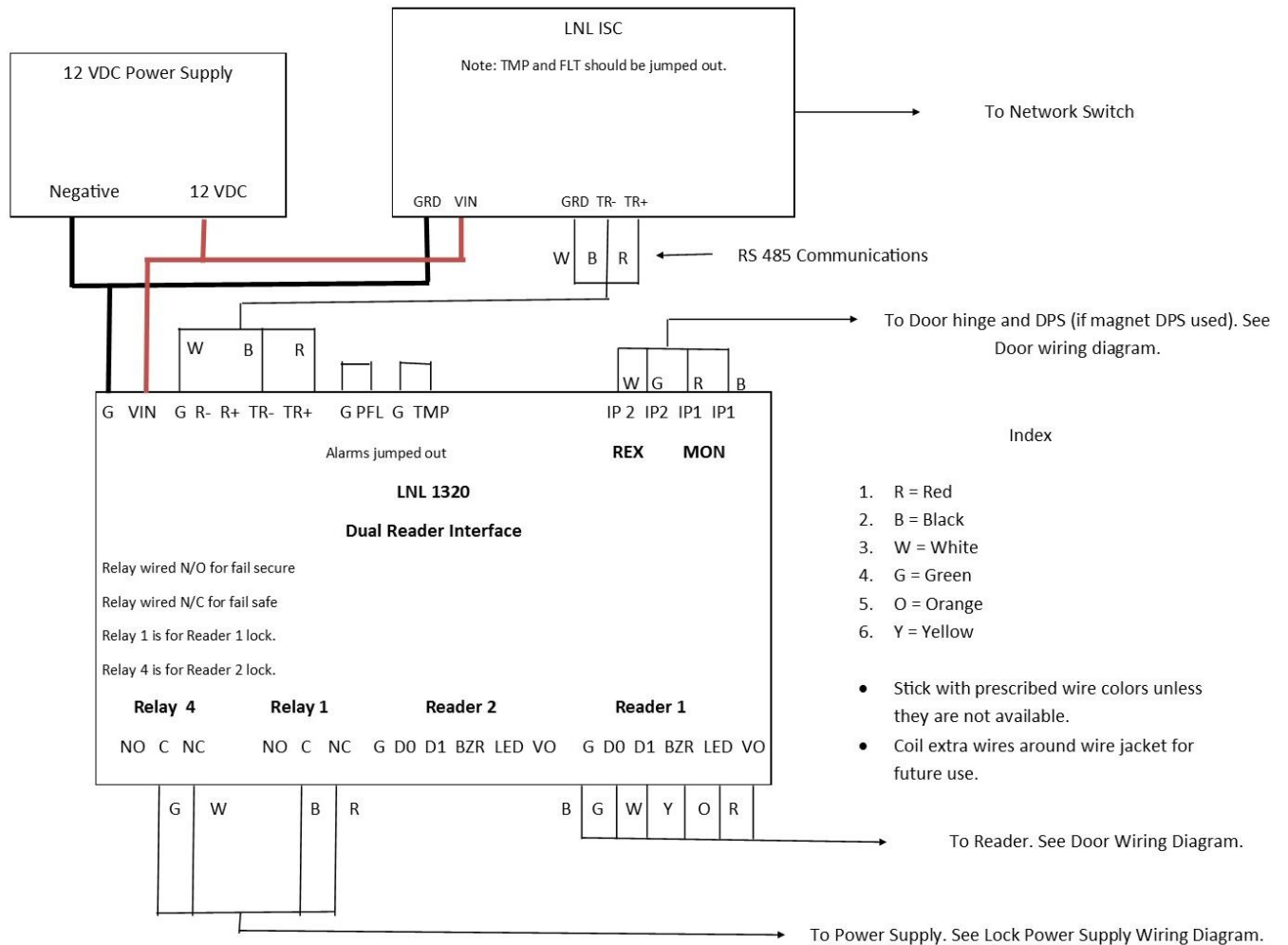
UNCW Lock Power Supply Wiring



Index

G - Green
 B - Black
 R - Red
 W - White

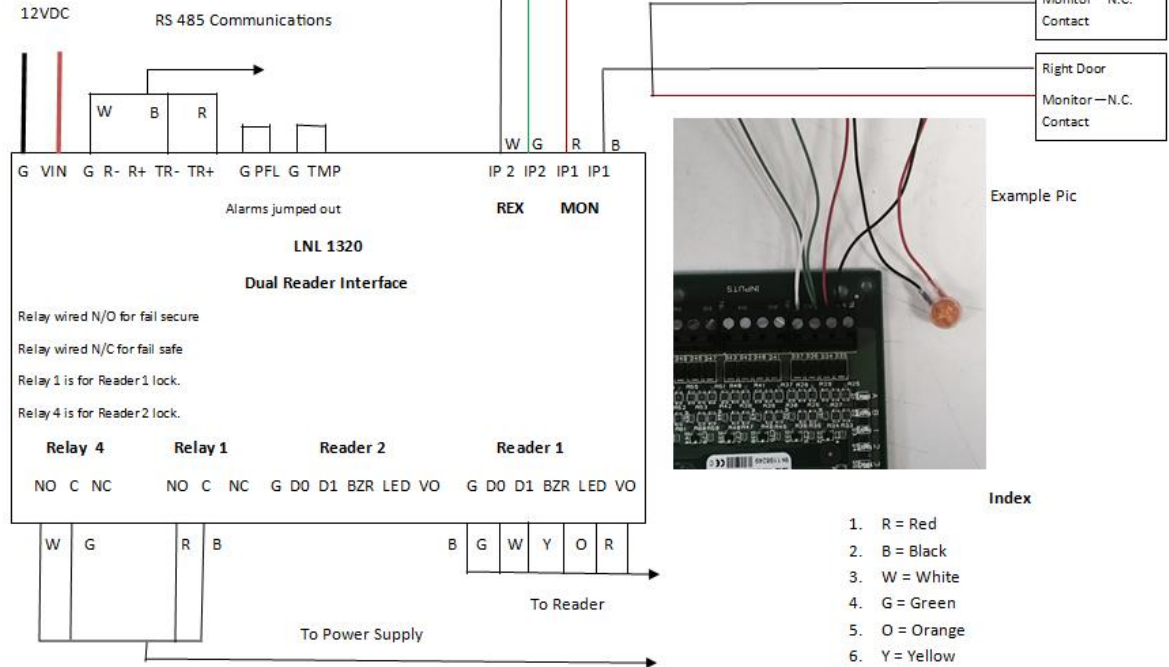
UNCW Level Panel Wiring Standards



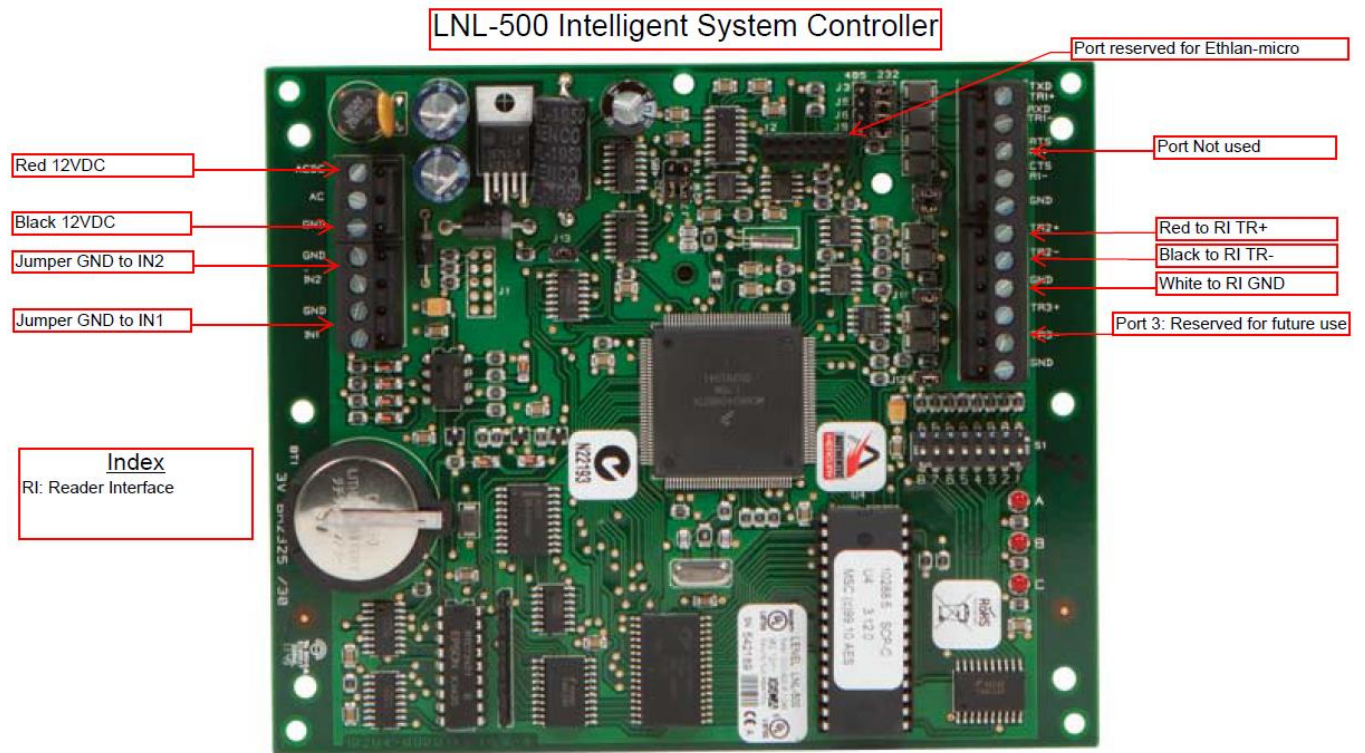
UNCW Lenel REX and Monitor Wiring for Double Doors

Request to Exit Switch (REX) - Normally Open Contact (N.O.) - Wired in parallel at input 2 for Reader 1 and input 6 for reader 2 on LNL 1320.
Wiring done at the panel **NOT** the door.

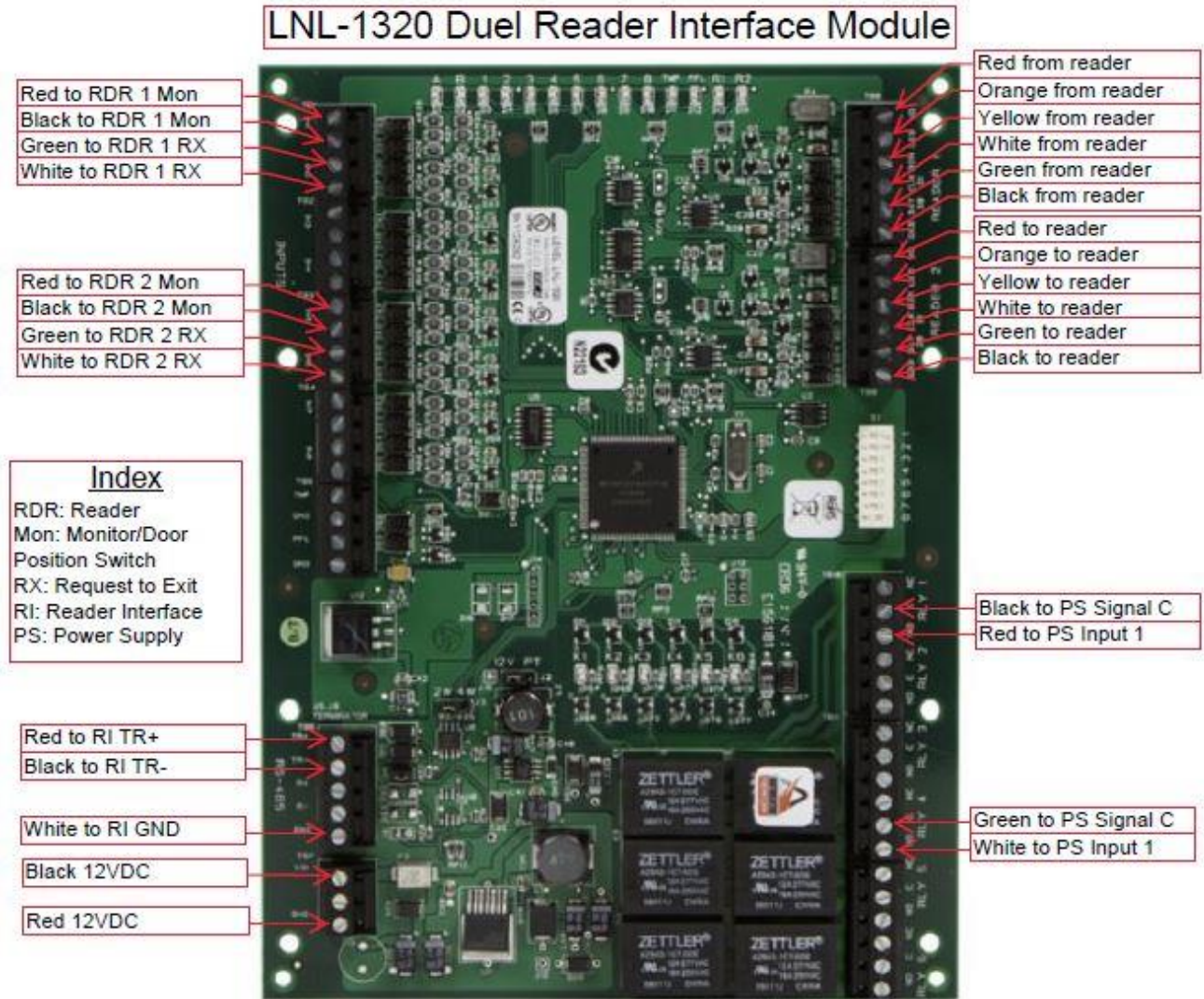
Door Monitors—Normally Closed Contacts (N.C.) - Wired in series at input 1 for reader 1 and 5 for reader 2. Wiring done at the panel **NOT** the door.



LNL-500 Wiring



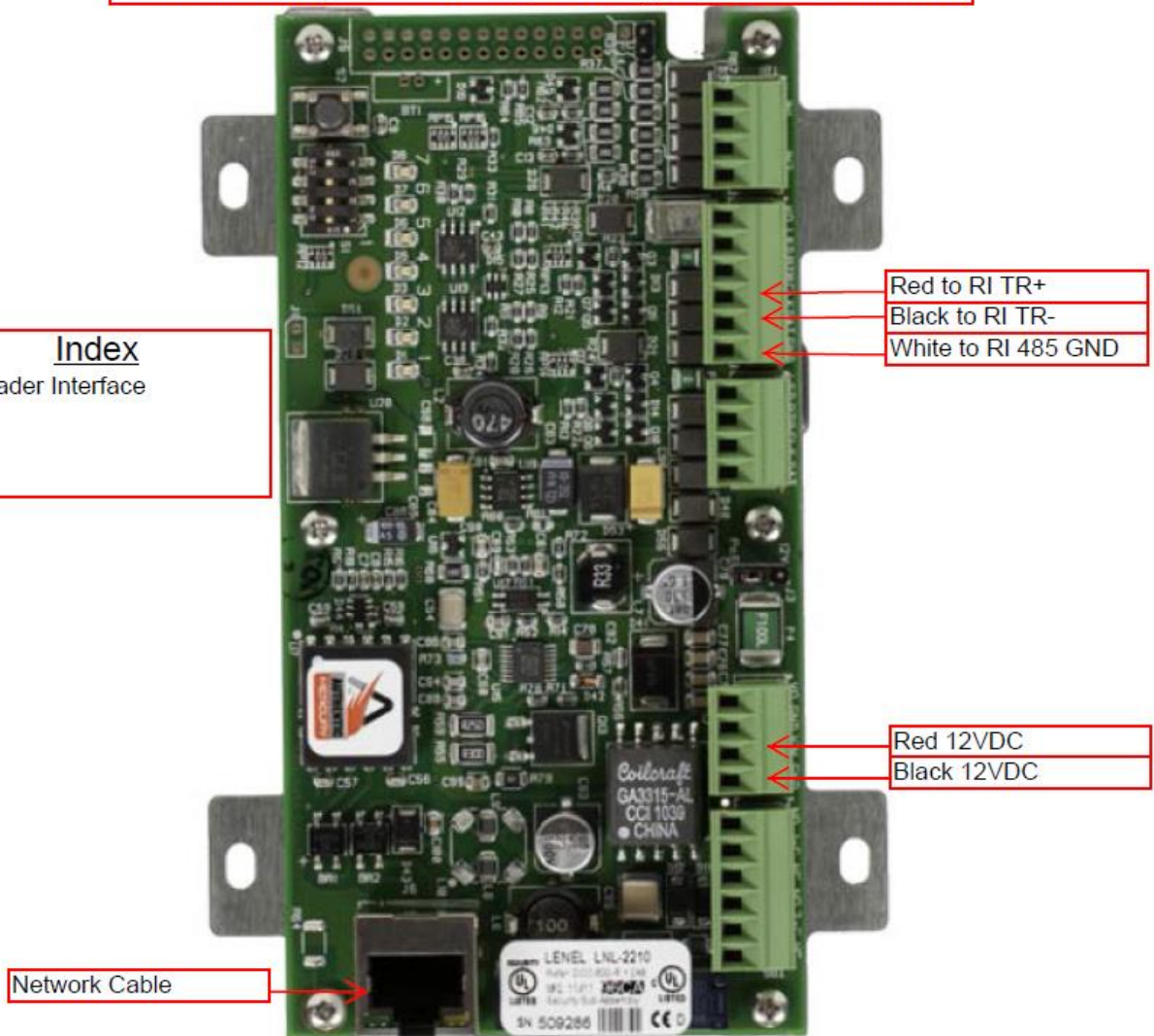
LNL-1320 Wiring



LNL-2210 (Wired as ISC)

LNL-2210 Intelligent Single Door Controller
Functioning as Intelligent System Controller

Index
RI: Reader Interface

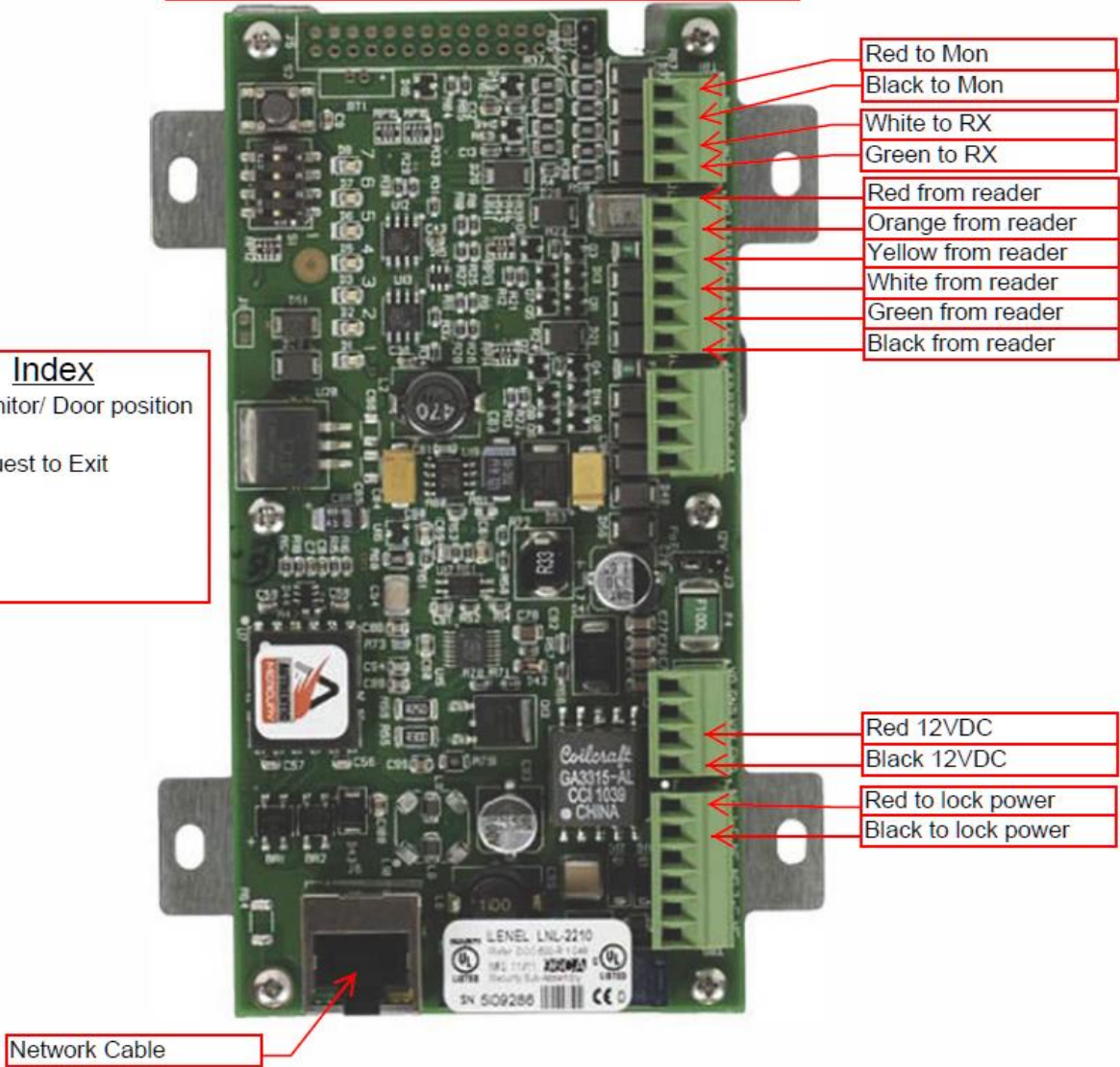


LNL-2210

(Wired as a Single Door Controller)

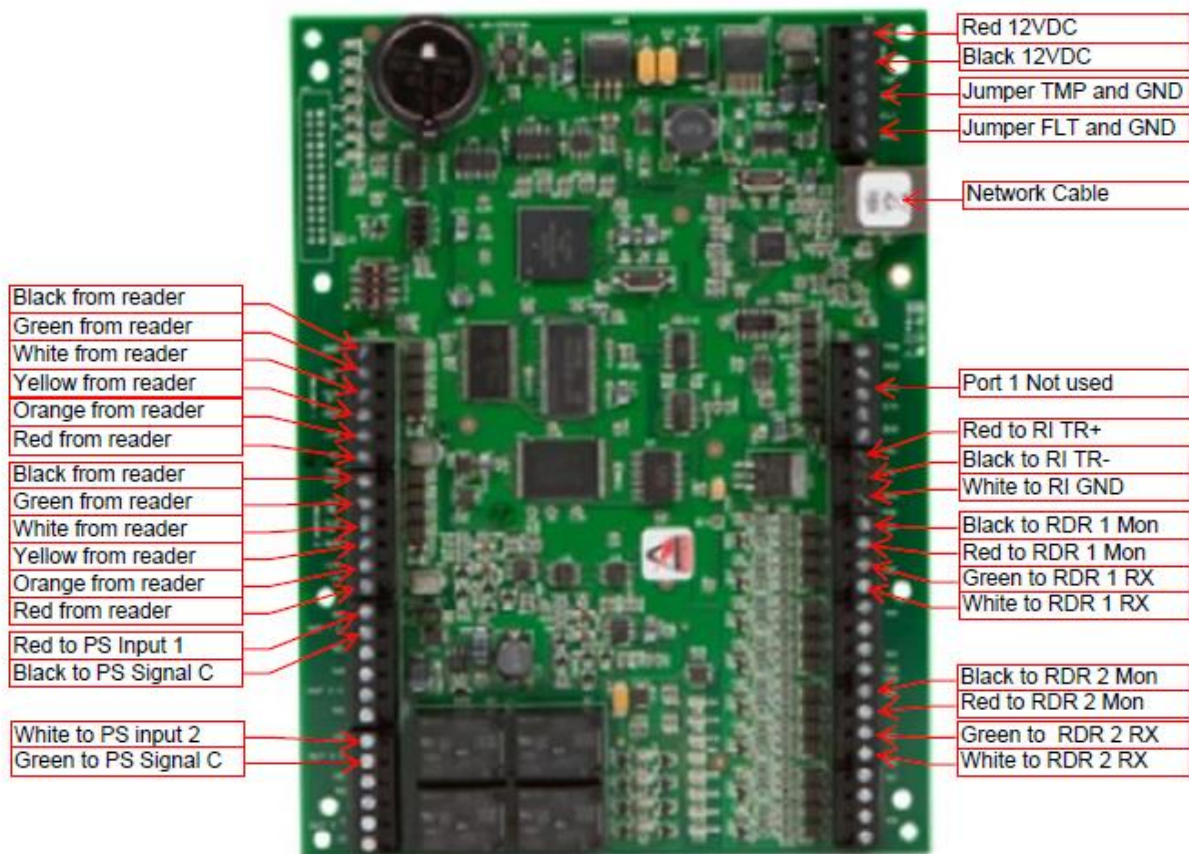
LNL-2210 Single Door Controller

Index
Mon: Monitor/ Door position
switch
RX: Request to Exit



LNL-2220

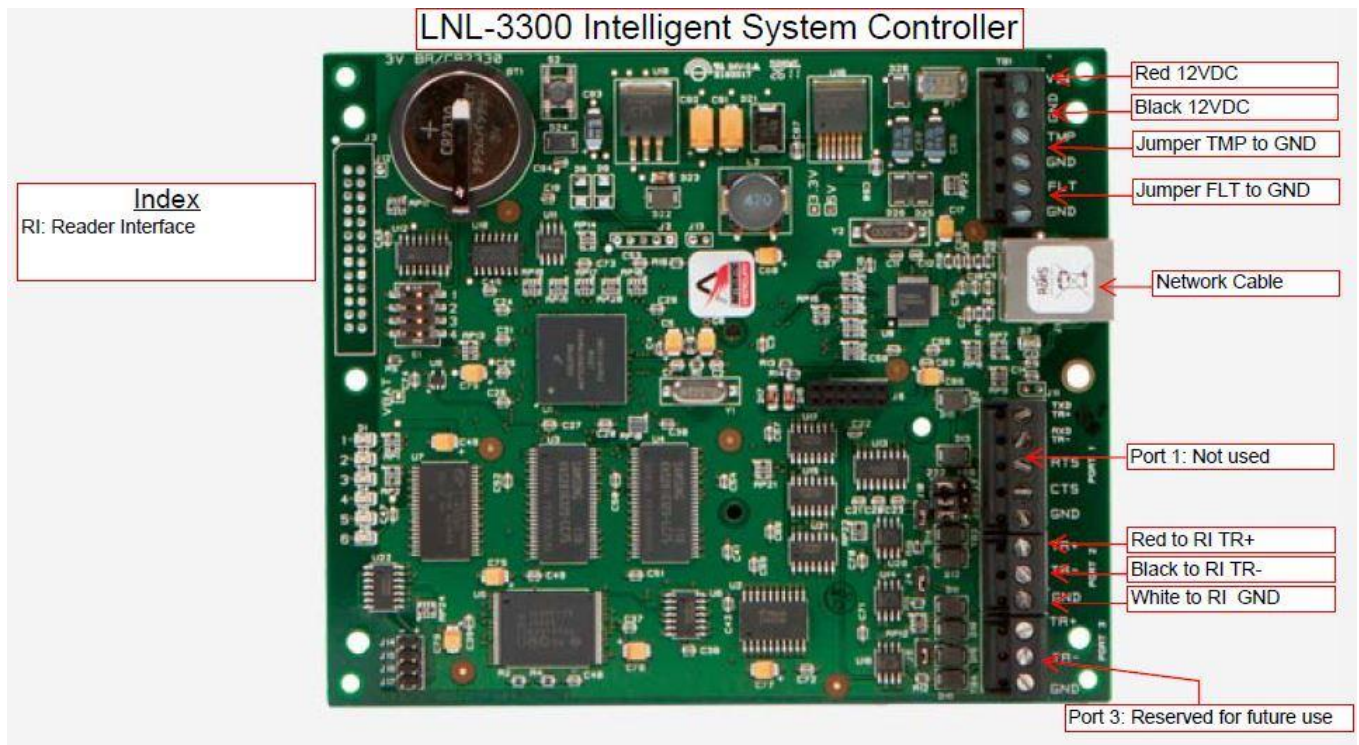
LNL-2220 Intelligent Dual Reader Controller



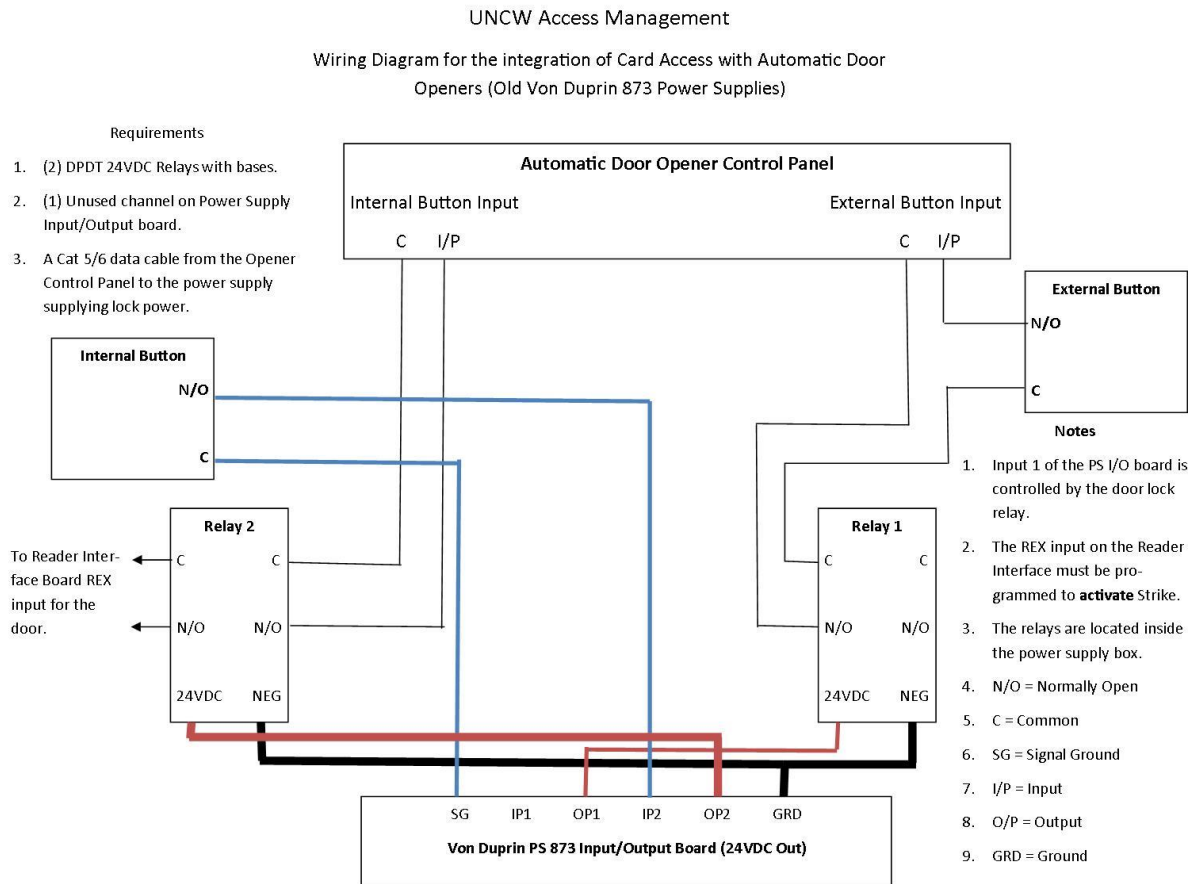
Index

RDR: Reader
Mon: Monitor/ Door position switch
RX: Request to Exit
RI: Reader Interface
PS: Power Supply

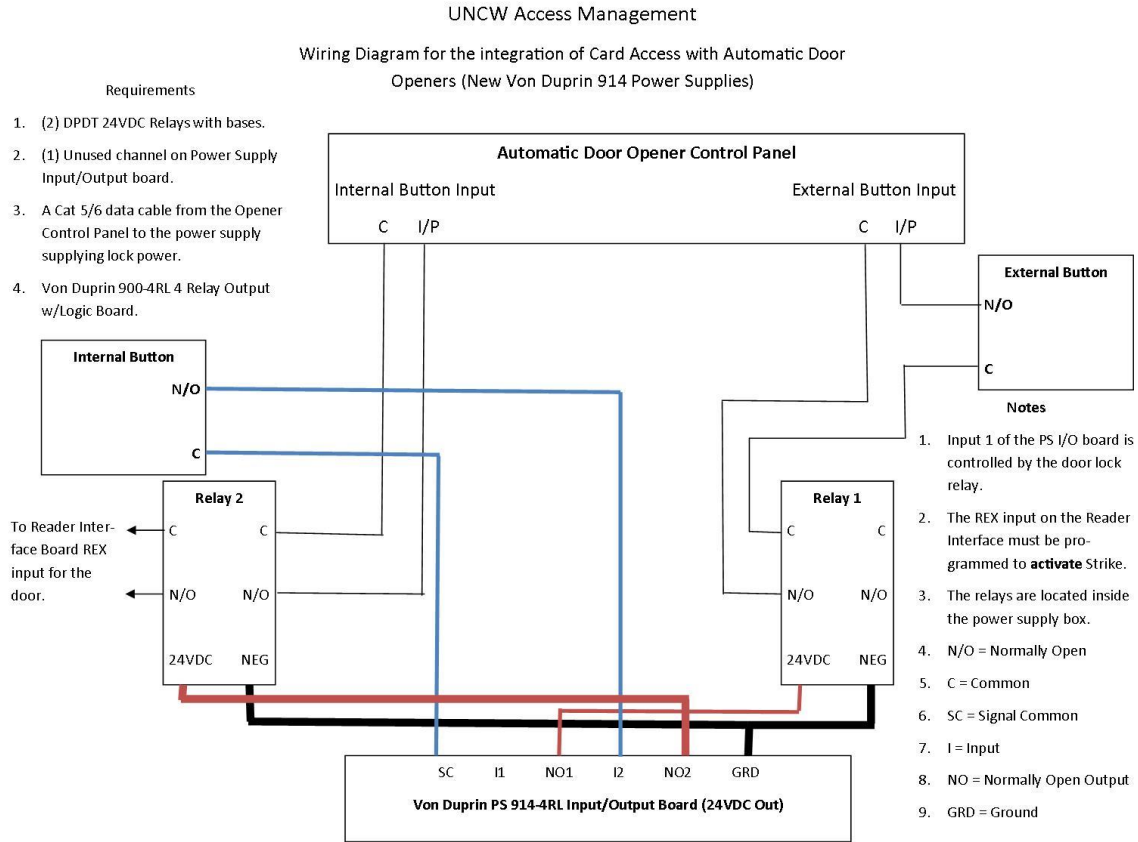
LNL-3300



Handicap Door Integration with PS 873 Power Supply



Handicap Door Integration with PS 914 Power Supply



UNCW Approved Parts List

Description	Part Number
Door Hardware and Power Supplies	
Electrified Von Duprin Crash Bars w/ Request to Exit Switch	RXLC EL(QEL) 99/98NL
Best Electric Mortise Lock w/ Request to Exit Switch and Internal Dead Bolt Thumb Switch with Indicator (Both parts required for complete unit)	45HW7TDEU14J626IDH24VPR 40HVITJ626
Von Duprin Power Supply with I/O Card	PS914-4RL
Hager Electric Hinges	BB1199/1191 ETW-8-US32D
Von Duprin Electrical Power Transfer	EPT-10
Select Electric Continuous Hinge w/ Removable Panel (NOTE: Part # will vary according to the handing of the door and position of the removable panel)	SL11-HD-EMS/CTW-8-RP-Clear
Von Duprin Chexit Device	CX98/99 NL x 0 second Delay
Von Duprin Crash Bars w/ Request to Exit Switch (no EL Kit)	RXLC 99/98NL
Relay for Handicap Door Integration Relay, 8Pin, DPDT, 10A, 120VAC	Omron LY2-AC110/120 or equal
Relay Base for Handicap Door Integration Relay	Dayton 10E075 or equal
Allegion AD400 Wireless Lock	AD400 (lockset) 40-SIK-SPA-626-BD
Allegion PIM (RS-485)	LNL-PIM400-485
Allegion PIM (Network)	LNL-PIM400-1501
RK-40 HID iClass Keypad Reader with terminal	921NTNTEK0004L
RK-40 HID iClass Keypad Reader with pigtail	921NTNNEK0004L
R-40 HID iClass Reader with terminal	920NTNTEK0003V
R-40 HID iClass Reader with pigtail	920NTNNEK0003V
R-10 HID iClass Mullion Mount Reader w/ terminal	900NTNTEK0004F
R-10 HID iClass Mullion Mount Reader w/ pigtail	900NTNNEK0004F

Revision Notes

- Rev. 082011 – Added new model of Von Duprin Power supply
Added LC (low current) RX switch to standards
Removed pneumatic handicap door opener
- Rev. 022014 – Allow contractors to install complete card access systems.
Standard lock power supply was changed to a Von Duprin PS914-4RL.
Diagrams detailing lock power, door, and panel wiring were added.
- Rev. 012715 – Includes diagrams of Access Management expectations when installing Lenel panels and power supplies in security rooms/closets by contractors. Updated wiring and door installation diagrams.
- Rev. 082715 – Added new drawing for wiring REX and monitor for double doors in parallel.
- Rev. 091115 – Updated model of hinge used to no longer include monitor. Declared first choice for door monitoring preference as magnet door position switch and second choice as plunger style, including drawings to showing wire installation.
- Rev. 030716 – Updated drawings for wiring requirements and removing any name reference to Business Applications.
- Rev. 102116 – Updated drawings to remove references to monitored hinges.
Updated department name from Access Management to Physical Security and access.
Added Lenel parts verification to standards.
- Rev. 012417- Added wireless device policy
Added statement regarding pre-installation of equipment to PS&A office
- Rev. 020817 – Updated policies & part numbers.
- Rev. 061917 – Added Wireless device standards. Amended lock power wire gauge and maximum distance standards. Added requirement for installation technicians to be Lenel certified. Added documentation and drawings for wiring of Lenel ISC boards. Added wireless parts and part numbers to Approved Parts List.
- Rev. 110817 – Added Best Electric Mortise Lock for use at internal doors and removed the Schlage Electric Mortise Lock. The verbiage in various places has been edited to reflect slight changes in standards or improve legibility.
- Rev. 071918 - Change to correct Best Mortise Lock part numbers.
- Rev. 120518 – Add HID Reader and Part Number documentation.

UNCW Physical Security and Access

Contact Information:
Accessmgmt@uncw.edu
(910)962-3564

Please contact the Physical Security and Access Manager with any questions or concerns pertaining to this document.

SECTION 282300 - SECURITY SURVEILLANCE CAMERA SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Building Surveillance Camera System per UNCW standards.

1.2 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specifications, Divisions 26, 27 and 28 Specification Section, apply to this Section.
- B. Section 26 08 00 - Commissioning of Electrical

1.3 REFERENCES

- A. NECA (National Electrical Contractors Association) "Standard of Installation."
- B. NFPA 70 National Electrical Code.
- C. STS-1000 Telecommunications Wiring Guidelines.
- D. UNCW-ITS "Infrastructure Standards For Installation" Rev. 06/01/2019.
- E. UNCW Physical Security and Access: "Standards And Procedures Security Room Construction/Renovations", Rev 06/2017.
- F. UNCW Physical Security and Access: "Standards and Procedures Installation of Access Control Equipment". Rev. 12/05/18.
- G. UNCW Physical Security and Access: "Standards and Procedures Installation of Cameras and Camera Systems". Rev. 06/28/17.
- H. TIA/EIA-568: Telecommunications Industry Association of the Electronic Industries Alliance (EIA)

1.4 SUBMITTALS:

- A. Product Data for system components
- B. Equipment connection details and electrical power requirements.
- C. Typical device connection details.
- D. System single line diagram including all devices and components.
- E. Terminal schedules

1.5 PROJECT RECORD DOCUMENTS

- A. Record actual locations of Products; indicate actual circuit arrangement.

1.6 OPERATION AND MAINTENANCE DATA

- A. Maintenance Data: Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with NECA Standard of Installation.
- B. Maintain one copy of each document on site.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Installer: Company certified and in good standing with the manufacturer for the installation, programming, configuring of the products specified in this section with minimum three years documented experience.

1.9 REGULATORY REQUIREMENTS

- A. Furnish products listed and classified by third party agencies accredited by the NCBCC to label electrical and mechanical equipment, as suitable for purpose specified and indicated, where such listing exists.
- B. Conform to requirements of NFPA 70.
- C. Conform to requirements of STS-1000.

1.10 PROJECT REQUIREMENTS

- A. Comply with applicable requirements of Appendix A “Standards and Procedures Installation of Cameras and Camera Systems”. Rev. 06/28/17 Authored by UNCW Physical Security and Access for a fully functional system.
- B. Comply with applicable requirements of Section 28 13 00 Appendix A “Standards and Procedures Security Room Construction/Renovations, Rev 062017” Authored by UNCW Physical Security and Access.
- C. Comply with the applicable requirements of Section 28 13 00 Appendix B “Standards and Procedures Installation of Access Control Equipment”. Rev. 12/05/18.
- D. Comply with the applicable requirements of UNCW-ITS “Infrastructure Standards For Installation” Rev. 06/01/2019.

PART 2 - PRODUCTS

2.1 SECURITY CAMERA COMPONENTS

- A. See Equipment and device schedule on drawings.
- B. Software and licensing needed for system operation and configuration for a minimum of one workstation is included.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Demonstrate specified system functions to the owner.

3.2 DOCUMENTATION

- A. Provide complete system documentation

3.3 TRAINING

- A. Provide owner system training for no less than 4 hours to cover operation, configuration, interfacing with the system and any detailed questions of the trainees.
- B. Include video recording of owner system training.

3.4 WARRANTY

- A. Refer to warranty requirements per the project manual.

END OF SECTION 282300

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APPENDIX A

**Standards and Procedures Installation of
Cameras and Camera Systems**

University of North Carolina Wilmington, Rev. 06/28/2017



Standards and Procedures

Installation of Cameras and Camera Systems
At
University of North Carolina at Wilmington

UNCW

REV 062817

Provided by UNCW Physical Security and Access

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OVERVIEW

The purpose of this document is to define the standards and procedures for the installation of security cameras, security camera systems and all ancillary equipment on the campus of the University of North Carolina at Wilmington (UNCW) and all properties owned or leased by the university.

The integrity of all equipment, cabling and proper installation is essential to the University's commitment to providing a safe and secure environment for students, faculty, staff and visitors of UNCW. These standards and procedures will be reviewed and updated regularly to ensure that are up-to-date and accurate.

All standards and procedures in this document shall be compliant with all relevant laws or directives set forth by the Federal Government, the State of North Carolina, The University of North Carolina System and the University of North Carolina at Wilmington. In addition, all contractors installing security camera equipment on property owned or leased by the University of North Carolina at Wilmington shall be fully licensed in the State of North Carolina pursuant to N.C.G.S. 74D, the Alarms Systems Licensing Act.

Responsibilities

UNCW

1. Prior to installation a “Kickoff Meeting” shall be held to include all parties with duties and responsibilities during the installation process. The purpose of the meeting is to ensure that everyone is clear as to their roles and that all UNCW policies and standards in regard to security cameras and their installation are satisfied.
2. UNCW shall provide the approved camera make, type and models that are approved at the time of bid or installation.
3. UNCW shall provide, install and maintain the system video servers. The specifications for the server shall be provided by the UNCW Physical Security and Access.
4. UNCW shall provide all network equipment to include network switches. The UNCW Network Data Analyst shall assign switches, ports and IP addresses for use in new camera installations.
5. The UNCW Physical Security and Access Manager, shall provide user names, passwords and IP addresses to the contractor.
6. UNCW Physical Security and Access and a UNCW Police Department representative shall approve the final aiming and focus.
7. The UNCW Network Infrastructure Analyst shall monitor the installation to ensure that all UNCW NetCom Department standards are satisfied.
8. Upon completion of the installation a final meeting may take place to include the UNCW Department that requested security cameras, UNCW Physical Security and Access, the UNCW Project Manager in charge of the project, the UNCW Network Infrastructure Analyst and the UNCW Network Data Analyst. This group shall review the installation to be sure all requirements and standards have been met before the contractor has been released from the job.

Contractors

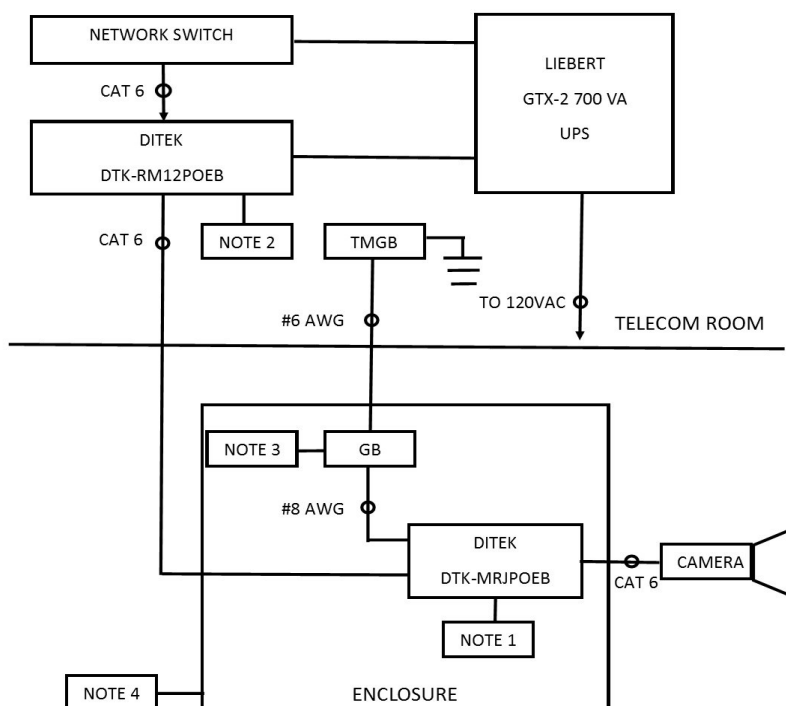
- The contractor shall ensure that they are operating in compliance with North Carolina General Statute 74D. (Alarms Systems Licensing Act)
- The contractor shall provide and install all cameras, ancillary equipment or parts required for a complete installation as specified by UNCW standards. Any substitutions **must** be submitted to the UNCW Physical Security and Access Manager for approval.
- The contractor shall provide and pull all data cabling and ground wire as required.
- The contractor shall ensure that the latest firmware approved for use with LENEL video software is installed in all cameras. Contact the UNCW Physical Security and Access Manager for firmware version.
- The contractor shall program cameras with the IP address, user name and password provided by the UNCW Physical Security and Access Manager.
- The contractor shall label all cables and wires. Camera labeling shall conform to the UNCW Physical Security and Access standard. Contact the Physical Security and Access Manager for more information.
- The contractor shall schedule a time with the Physical Security and Access Manager and a UNCW Police Department representative to approve the final aiming and focus of all installed cameras.
- All cameras shall be compatible with the current software version of Lenel OnGuard Access Control and Security System in use at UNCW.
- Camera security systems shall include a system of **Surge Suppression** that conforms to the standards set forth in this document.
- Cabling and cabling installation shall meet or exceed all specifications as per the Standards for Installation of Infrastructure and Telecommunication Equipment provided by UNCW NetCom Department. The UNCW Network Infrastructure Analyst shall be the point of contact for all issues that pertain to the cables, patch panels and other telecommunications equipment.
- Camera systems shall conform to the approved equipment list and application schematics provided in this document.
- The contractor shall provide “As Built” drawings to UNCW Physical Security and Access.

Cameras

UNCW Camera Requirements

- Internal and External cameras shall be vandal resistant.
- External cameras shall be built to withstand the extreme temperature and coastal weather conditions of southeastern North Carolina.
- Cameras shall include day and night functionality.
- Cameras shall have a minimum 2.0 MP resolution.
- Cameras shall be minimum H.264 compatible.
- All cameras shall be compatible with the latest versions of Lenel OnGuard in use by UNCW.
- Cameras shall conform to the list of approved make, types and models provided by UNCW Physical Security and Access. Contractors shall be provided the approved list upon request.

Camera Surge Protection Notes



1. Provide Cat 6 Surge Protector (DTK- MRJPOE) in an enclosure located within 6 feet of each camera.
2. Provide rack mounted Ditek DTK-RM12POE 12 port Surge Protection Patch Panel. Surge Protection Patch Panel shall be grounded using #8 AWG wire to TMGB or Security Room Grounding Block.
3. Provide Ground Bar in enclosure to provide a connection to ground for camera surge protectors.

The distance between the Ditek MRJPOE modules and ground should be less than the cable distance between the module and the camera it protects.

Provide #6 AWG, Green, Insulated, and Stranded Ground Conductor from TMGB in Main Telecom Room to Ground Bar. Provide #12 AWG, Green, Insulated, and Stranded Ground Conductor from Ground Bar to each camera Surge Protector.

4. Provide hinged enclosure located within 6 feet of each camera to house DTK-MRJPOEB and Ground bar.
5. If Network Switch and Ditek Patch Panel are not located in a Telecom room the contractor shall install a local grounding block as per UNCW Netcom standards.



Grounding 101

*Technical White Paper
Page 1 of 3*

The service life of any piece of electronically controlled equipment is, to a large degree, determined by the quality of the electrical service that it receives power from. The number one complaint from electronics (commercial and residential) owners is downtime. The number one cause of downtime (other than user error, neglect, or abuse) is poor power quality. According to Utility Industry information, power quality is at an all time low, and with deregulation rolling along, it's getting worse.

A low impedance ground is imperative to both surge protection designs and power quality. A regular check and upgrade (as needed) of grounding systems will reduce interference and line noise, improve power factors, reduce the risk of accidental electrocution, help decrease potentially damaging harmonics and improve the efficiency and durability of surge protection equipment. Since many electricians use the terms "bonding" and "grounding" interchangeably, for the purpose of this paper they will be defined in short, as follows:

Ground/Grounding – Any direct conducting connection between an electrical circuit or equipment and earth.

Bond/Bonding – The permanent connection of metallic parts to form an electrically conductive path.

An example would be an electrical service panel that is grounded while the telecommunications rack is bonded to the grounding system.

A primary concern that needs to be addressed when beginning any power quality survey is the need for a "complete" grounding and bonding system, between the electrical service entrance and remotely grounded buildings or equipment. If the remote ground home runs back to the service entrance, it will be a relatively simple process to create a "single point ground" that will reference the initial utility company electrical ground back at the service entrance electrical meter.

Articles 100 and 250 of the NATIONAL ELECTRIC CODE (NEC) describe an acceptable ground as being rated at 25 Ohms of resistance or less, and requirements to achieve this. Optimum performance of surge protectors is achieved at five Ohms or below. Several manufacturers of electronic equipment also require five to ten Ohms as a maximum resistance for their gear to work correctly. Failure to properly ground the metal parts of the electrical system to the earth can result in electric shock, fires and the destruction of expensive electronic equipment from lightning and high voltage line surges. We realize that in many areas of the country you may be starting with 350 ohms or more, instead. However, there are several preliminary tasks that we can perform to reduce that number to a more acceptable level.

The first (and most important) task to undertake is the actual measurement of resistance to ground at the service entrance meter's electrical ground, or of the soil itself. Several things can affect the actual resistance of the soil, including moisture content, quality and type of electrolytes, conductive objects, temperature, depth and spacing of the ground rods. This critical measurement can be accomplished in one of two ways... either by the use of a special "clamp-on" ground resistance measuring device (good for existing locations) or an earth resistance meter ("Megger") (preferred in new installations). Although the earth resistance meter is less expensive, it requires the use of multiple ground probes and leads from the tester with specific distance requirements between rods and measurements to be plotted on a nomograph in order to calculate the actual resistance of the ground.





Grounding 101

Technical White Paper
Page 2 of 3

Another issue with the Megger is that they come in three and four terminal configurations. To test the actual resistivity of the soil itself, a four terminal model is required. The advantage of this method is that you are not connected to the electrical system during testing. An electrical line fault during testing can send high current to the grounding system. This could result in high current and voltage at the test leads and meter. Safety is a primary concern working on “live” electrical systems. Always use proper protection equipment. Remember, if you are in contact with the grounding system (particularly if the ground rod is disconnected) YOU are the ground for the system.

Once an accurate measurement of resistance to ground has been calculated, we can perform a few tasks to help reduce resistance even further. Since DITEK is in Florida, and geological features can vary greatly in other parts of the country, it will fall to the installing contractor to make the determination of how best to lower resistance to ground in his region. The recommended grounding conductor at the service entrance is specified by NEC based on the ampacity of the service.

1. Drive a new service entrance ground rod. Since it is impossible to know the exact length or current condition of the original ground rod, it may be prudent to install a new rod of suitable length and composition at the service entrance. Solid copper is the preferred material however, galvanized or copper clad may also be suitable if acceptable resistance levels are met.
2. Bond a new rod and the existing rod together. If the target ground resistance is not achieved by a new rod, drive a second rod and bond the two rods together by exothermic welding a piece of the grounding conductor between the two. The new rod should be approximately one rod length or more from the first rod. Multiple rods can be connected this way (See item #4 below). One additional rod will lower ground resistance by 40%. Two rods will result in a 60% reduction. Three rods will improve resistance by 66%.
3. Drive the rod deeper. Couple a new rod of equal length on top of the existing rod to effectively double the depth of the rod. Be sure to use rods of like type and a coupler matched to that type of rod. This will result in an approximate 40% reduction in ground resistance.
4. Create a “Ground Grid”. This procedure involves creating a grid of grounding electrodes, or rods, in close proximity (10 to 20 feet, or at least one rod length apart,) and welding or bonding the grounding conductor between the rods together. The entire grid is then backfilled with soil and compacted to complete the grid. Also, review NEC section 250-32(b) for more information.
5. Create a “Trench Ground” or “Ground Ring”. If your region provides a solid substrate such as bedrock immediately below a shallow layer of soil, it is possible to create a circular trench around the building (minimum 20 feet long) at least 30 inches deep utilizing a minimum of #2AWG bare copper conductor, lay in the grounding conductor, bond the two ends together to the ground rod, and then backfill the trench with soil. This allows maximum contact with the ground, yet need not be excessively deep to do the job.



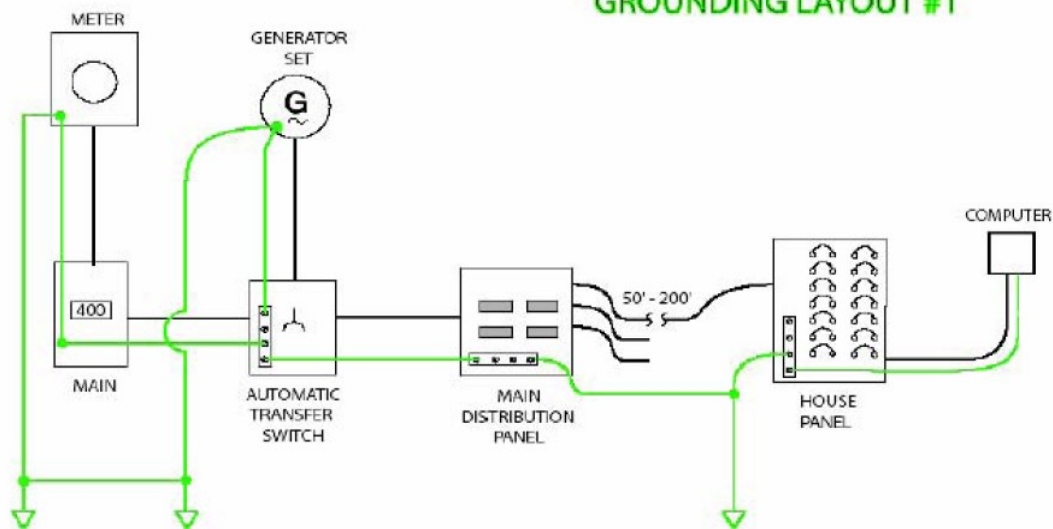


Grounding 101

Technical White Paper
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A key element to the creation of a complete grounding system may involve making some fundamental adjustments to the routing of the grounding conductor if more than one ground can be referenced (campus environments, etc.). This will not be difficult or time consuming, but is very important in the system's ability to reference the original equipment ground back at the service entrance utility service meter. The normal routing would be to bring the HOTS, the NEUTRAL and the GROUND wire into the remote electrical panel and terminate them to the appropriate busses. Then route the GROUND wire down to the house grounding electrode (ground rod). For our purposes, it is necessary to route the GROUND wire to the grounding electrode FIRST, and then up to the ground bus within the panel. This simple adjustment still follows NEC code, but provides an unobstructed pathway to divert surges to these ground rods while continuing to reference the service entrance ground. The fundamental result of this routing is the elimination of potential equipment damage from the ground loop created by multiple ground rods. It accomplishes this by allowing the electrical potential of the entire facility to rise and fall in a uniform manner, reducing the possibility of excessive current flow on the grounding system. Please note the diagram #1 for a sample layout.

GROUNDING LAYOUT #1



Finally, inspect and tighten all wiring terminations at the service entrance and at each of the remote panels, disconnects or equipment. It is surprising how over time, these terminations can loosen. It can make a substantial difference in lowering resistance to ground if these connections are inspected for oxidation, cleaned up and tightened down.



DTK-RM12POE

*Rack Mount Power Over Ethernet Surge Protection
Gigabit Ethernet General Product Specifications*



DITEK's RM12POE protects circuits that use state-of-the-art Power Over Ethernet connections. This 12-port, 1U Rack Mount surge protector is designed to protect midspans, injectors, PoE hubs, and other PoE network equipment. The DTK-RM12POE is ideal surge protection for PoE Network Video Recorders, Voice over IP (VoIP) systems, or any other multi-port system requiring power and data.

DTK-RM12POE

Product Features

- 12 port, RJ45 In/Out connection
- Field-replaceable individual modules
- Multi-stage, SAD technology, hybrid design provides the best possible protection
- Gigabit Ethernet data speed without signal degradation
- Complies with IEEE Std. 802.3af and 802.3at for Power Over Ethernet
- High wattage PoE Plus compliant

Specifications

Agency Approvals: UL497B

Standards Compliance:

CAT5e, EIA/TIA568A, EIA/TIA568B

Connection Method: RJ45 In/Out, 8 pins, 12 ports

Pinout: Data & Power – All 8 Pins (4 pairs)

Max Continuous Current: 1.5A

Data Rate: Gigabit Ethernet

Power Dissipation: 3,000W/pair (10/1000µs impulse)

Protection Modes: Line-Ground (All)

Operating Temperature: -40°F - 158°F (-40°C - 70°C)

Maximum Humidity: 95% non-condensing

Dimensions: 1.75" x 19.0" x 2.75"

(45mm x 483mm x 70mm)

Weight: 1.67lb (.76kg)

Housing: Galvanneal Sheet Metal

Warranty: Ten Year Limited Warranty

Performance Data

	DTK-RM12POE
Service Voltage	48V – 54V
MCOV	64V
Clamp Voltage	72V
Peak Surge Current	30A/pair





DITEK Corporation
One DITEK Center
1750 Bailey Road
Largo, FL 33771

INSTALL INSTRUCTIONS

DTK-RM12POE

This Surge Protective Device (SPD) is a high performance device, designed to provide protection for sensitive electronic loads connected to service panels, fire panels, or where the SPD is directly connected to the electronic device. Maximum protection will only be achieved if the SPD is properly installed.

Please read and follow the installation instructions carefully.

NOTICE: This SPD should be installed by a qualified electrician in accordance with the National and Local Electrical Codes and the following instructions.

APPLICATION

Surge suppression for rack mount PoE Network Equipment and systems.

INSTRUCTIONS

Note: This device is intended to be installed indoors on the equipment rack closest to the point of use.

1. Test circuit prior to install to verify correct operation.
2. Turn off the power to the equipment to be protected.
3. This device can be mounted in a standard 19" equipment rack, or wall mounted using a hinged wall mount bracket.
4. Connect to equipment ground using the ground lug provided on rear of faceplate. Use a minimum #10 AWG wire.
Make sure the ground wire length is less than the jumper wires to the protected equipment.
Ground Resistance Rule: Max ground resistance is 25 Ohms, 5 Ohms or less is optimum.
This cannot be an assumed value and must be measured to assure proper grounding.
5. Plug the RJ45 connector tipped cable from the field or supply wiring to the "IN UNPROTECTED" RJ45 jack.
6. Plug a 3' RJ45 male to RJ45 male patch cable from the "OUT PROTECTED" RJ45 jack to the equipment to be protected. The 3' patch cable will give this device time to react.
7. After all connections have been made and no hazards exist, restore power to the equipment.

Surge Module Replacement: This product is made up of 12 individual surge modules.

If 1 or more channels self sacrifice, you can replace that module as follows.

1. Power down the equipment before servicing this device.
2. Disconnect the ground wire from the ground lug located on the rear of the enclosure.
3. Remove the enclosure from its mounting and place on a flat surface.
4. Remove 4 screws holding front and rear cases together. Save these screws.
5. Remove the hardware from the specific module with the bad port, remove module. Be careful to save all hardware.
6. Insert new surge module into opening aligning RJ45 connectors. The orientation should match the previous module.
7. Replace hardware and tighten.
8. Join front and rear cases together and fasten with the screws previously removed.
9. Re-connect the ground wire to the ground lug on the rear of the enclosure.
10. Re-mount the enclosure.
11. After all connections have been made and no hazards exist, restore power to the equipment.

DITEK Technical Support Available 24/7

1-888-472-6100

www.ditekcorp.com

Drawn By: R. Mitchell 3-22-12
Approved By: H. Tu 3-22-12

Doc # INT-100108-001
Part No. 191532 Rev. 3 3-22-12

INSTALLATION



DTK-MRJPOE

*Power Over Ethernet Power/Video/Data Surge Protection
Gigabit Ethernet General Product Specifications*

DITEK's MRJPOE protects circuits that use state-of-the-art Power Over Ethernet connections. This point of use surge protector can be installed either at the equipment end or ahead of injectors or midspan devices. The DTK-MRJPOE is ideal surge protection for PoE DVRs, NVRs, cameras, telephones and access control systems.



DTK-MRJPOE

Product Features

- Protects power, video and data on fixed or PTZ cameras
- RJ45 connection with external grounding screw
- Ethernet data speed without signal degradation
- Multi-stage, SAD technology, hybrid design provides the best possible protection
- Complies with IEEE Std. 802.3af and 802.3at for PoE
- Available as a single device or 12-Port, 1U Rack Mount (DTK-RM12POE)
- PoE Plus ready for high-wattage applications
- Ten Year Limited Warranty

Performance Data

	DTK-MRJPOE
Service Voltage	48V
MCOV	64V
Clamp Voltage	72V
Peak Surge Current	30A/pair

Specifications

Agency Approvals: UL497B

Standards Compliance:

CAT5e, EIA/TIA568A, EIA/TIA568B

Connection Method: RJ45 In/Out

Pinout: All 8 pins are protected

Data Rate: Gigabit Ethernet

Max Continuous Current: 1.5 Amps

Dissipation: 3,000W/pair (10/1000µs impulse)

Protection Modes: Line-Ground (All)

Operating Temperature: -40°F - 158°F (-40°C - 70°C)

Maximum Humidity: 95% non-condensing

Dimensions: 1.7" x 3.0" x 1.2"

(43mm x 76mm x 30mm)

Weight: 4oz (113g)

Housing: ABS





DITEK Corporation
One DITEK Center
1750 Bailey Road
Largo, FL 33771

INSTALLATION

INSTALL INSTRUCTIONS

DTK-MRJ45C5e / DTK-MRJPOE

This Surge Protection Device (SPD) is a high performance device, designed to provide protection for sensitive electronic loads connected to service panels, fire panels, or where the SPD is directly connected to the electronic device. Maximum protection will only be achieved if the SPD is properly installed.

Please read and follow the installation instructions carefully.

NOTICE: This SPD should be installed by a qualified electrician in accordance with the National and Local Electrical Codes and the following instructions.

APPLICATION

Surge suppression for circuits using CAT 5e cable and RJ45 connectors.

INSTRUCTIONS:

Caution: Measure all voltages to insure applied voltage does not exceed the voltage rating of the unit. Improper installation voids the warranty.

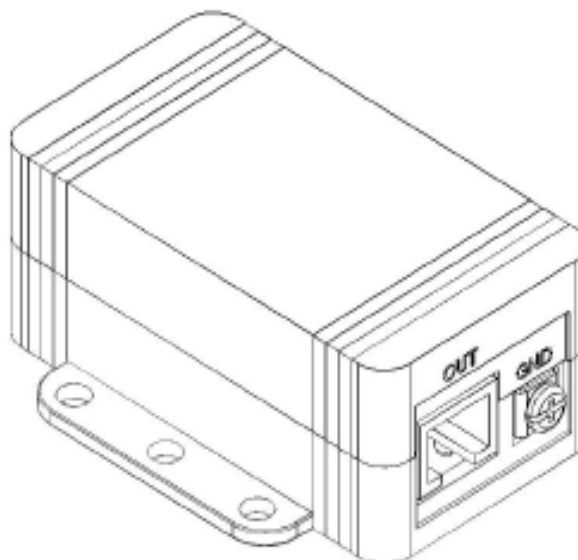
This unit must be connected in series with the equipment to be protected.

1. Connect the incoming wires to the "IN" connector.
2. Connect a CAT 5e patch cable from the "OUT" to the equipment to be protected.
3. Use one common ground per system to eliminate the possibility of a differential in ground potentials.

Ground Resistance Rule: Max ground resistance is 25 ohms, 5 ohms or less is optimum.

This cannot be an assumed value and must be measured to assure proper grounding.

4. For mounting, use double sided tape, or two (2) #8 screws.



DITEK Technical Support Available 24/7

1-888-472-6100

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Doc # INT-100101-001
Part No. 191529 Rev. 4

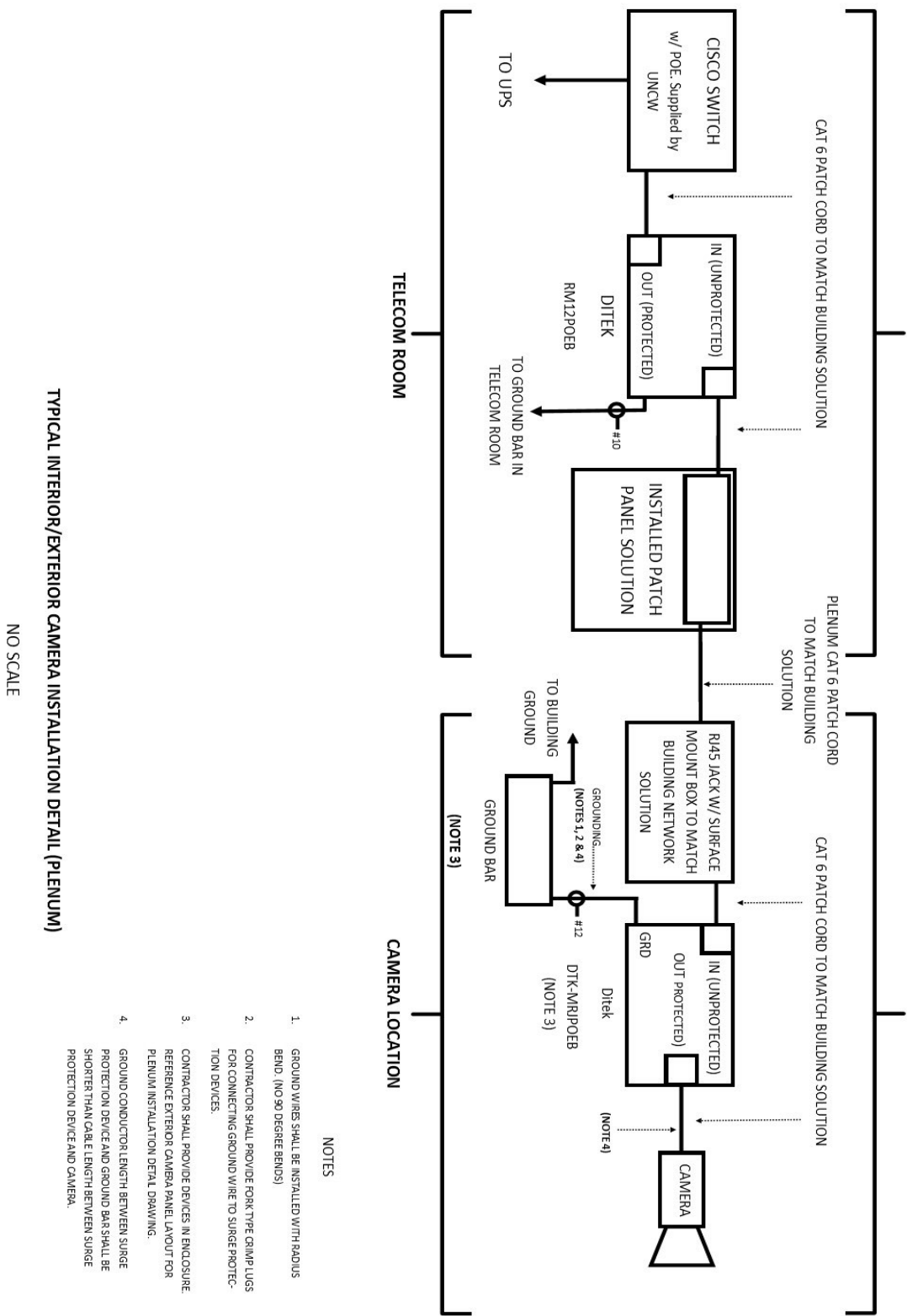
Drawn By: J.Ramirez 11-30-06
Approved By: R.Mitchell 11-30-06

Typical Installation Drawings

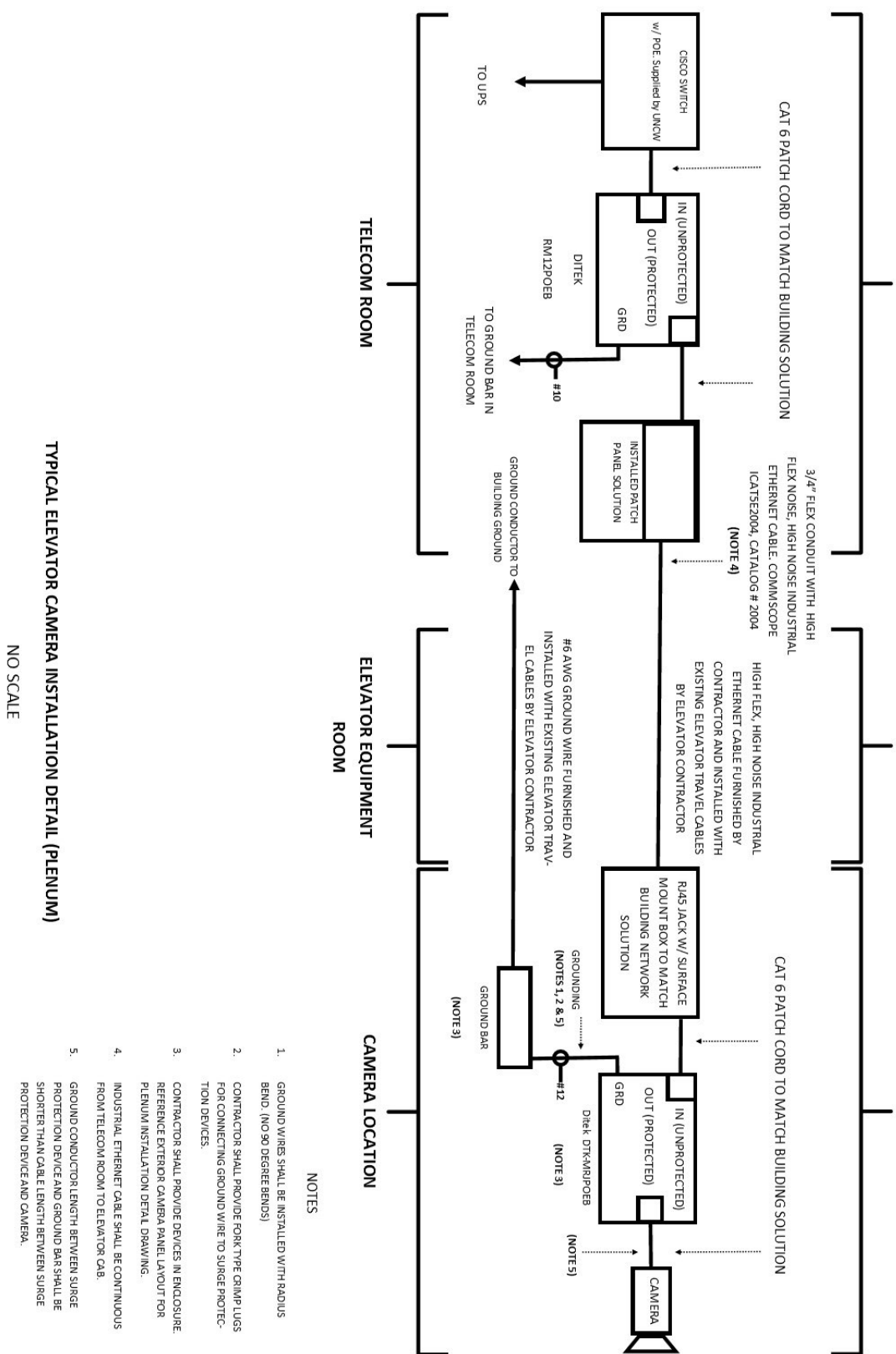
Included are examples of installations for exterior, interior and elevator cameras. These are intended as basic guidelines for future installations. UNCW understands that changes and revisions will be necessary to accommodate structural challenges, cost restraints, new technologies as well as differences in security requirements.

The examples included represent those that have thus far, proven the most effective in meeting campus security needs as well as providing the best protection of equipment. UNCW will continue to work with manufacturers, vendors, contractors and staff to develop new and cost effective standards that ensure quality, reliability and functionality.

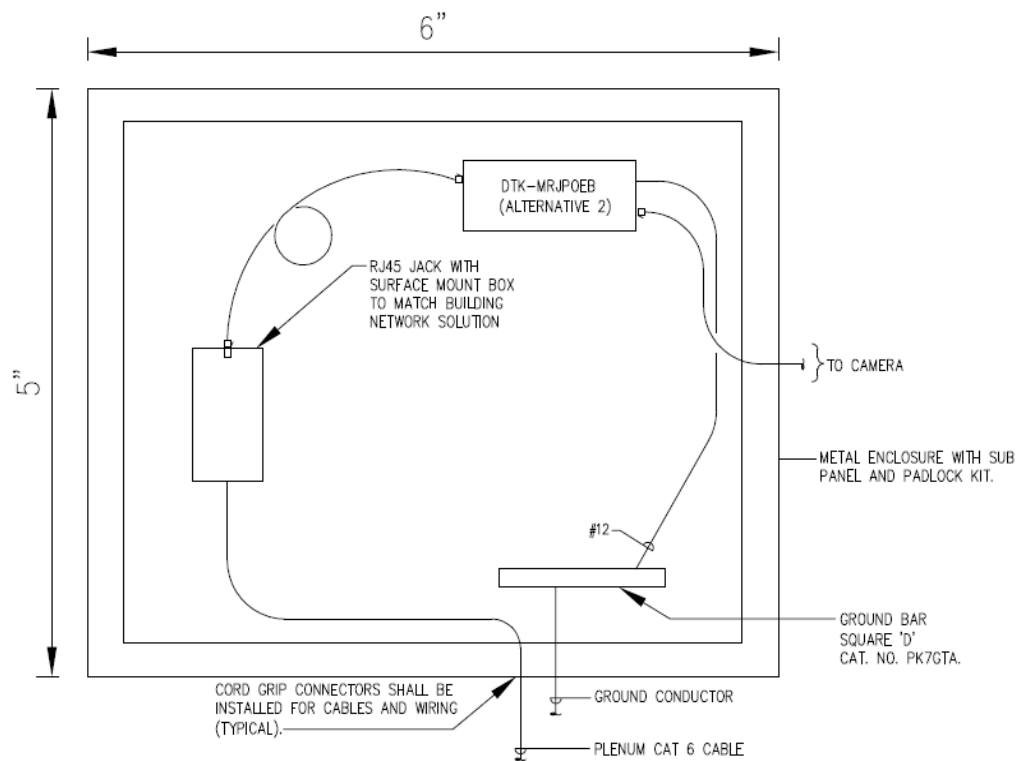
Typical Camera Installation



Typical Elevator Camera Installation

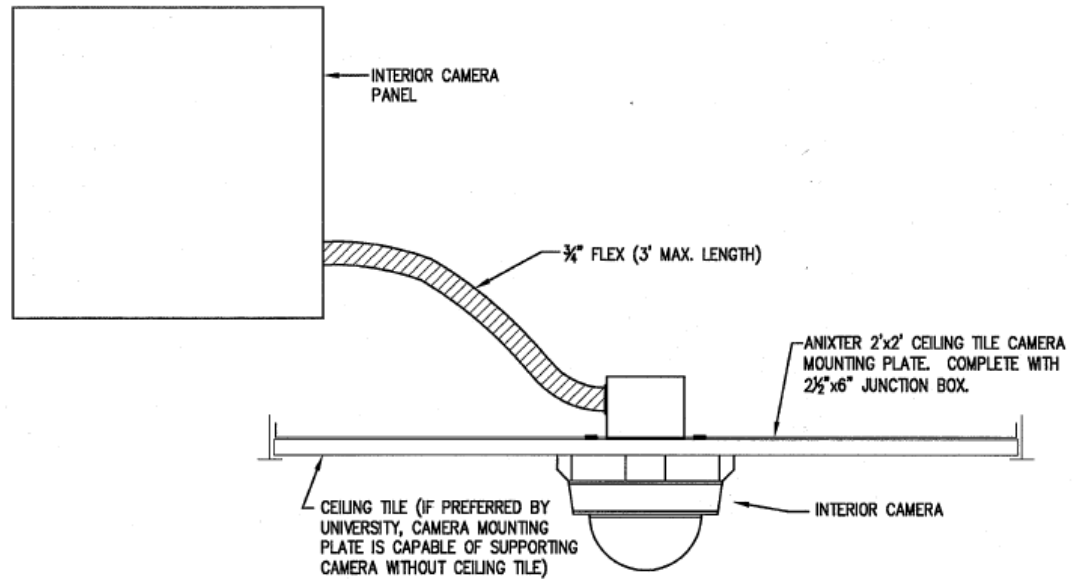


Typical Panel Layout



TYPICAL PANEL LAYOUT FOR PLENUM INSTALLATION
NO SCALE

Typical Interior Camera Mounting

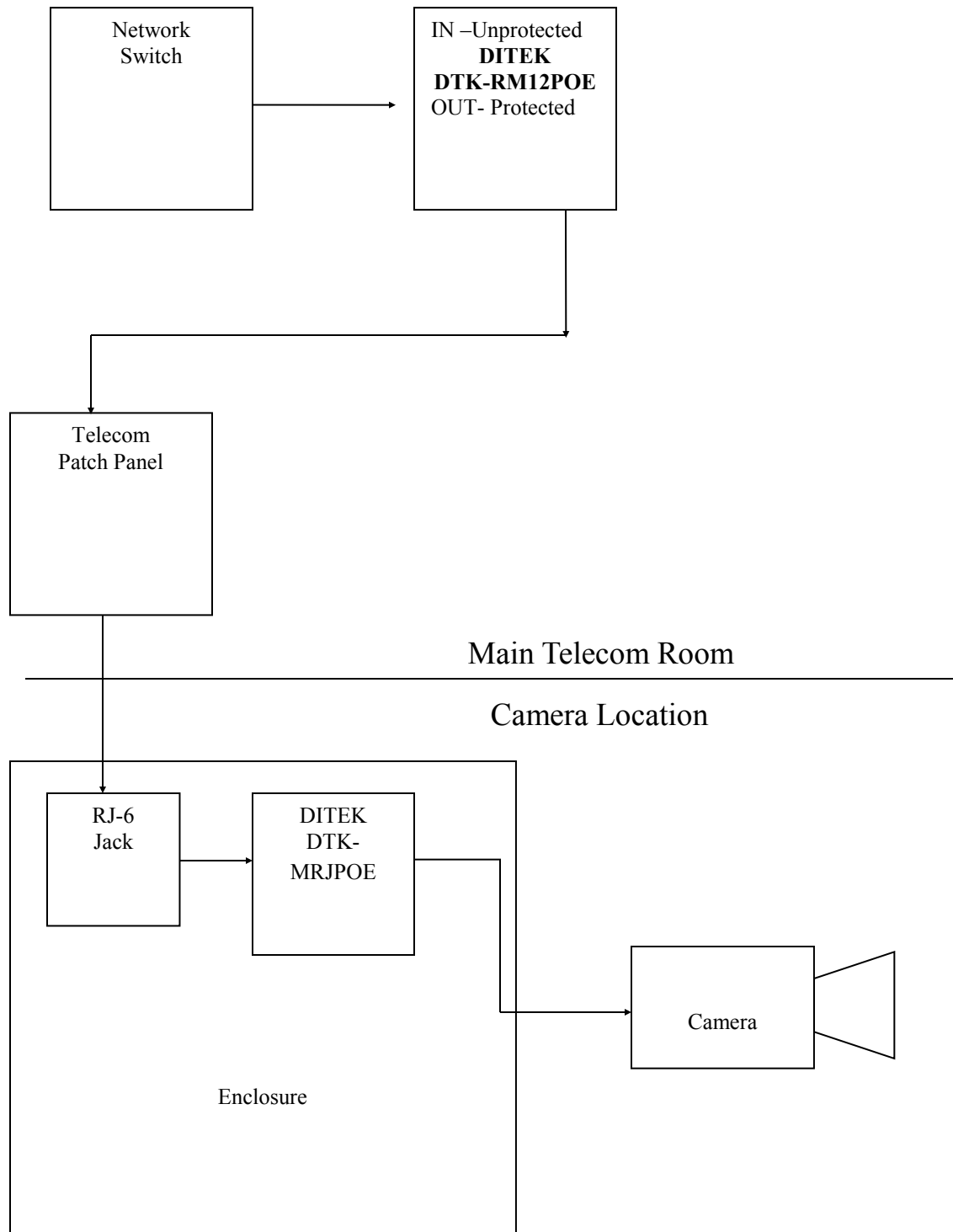


INTERIOR CAMERA MOUNTING DETAIL

NO SCALE

Dwg.# 080154-EB008.DWG

Typical Data/POE Signal Flow Chart



Parts List and Technical Data

Approved Parts List

Note: Contractor to provide all parts and cables necessary for complete installation.

	Description	Manufacturer	Part Number
1	Data Surge Protector	Ditek	DTK-MRJPOE
2	Rack Mount Data Surge Protector	Ditek	DTK-RM12POE
3	2x2 Ceiling Tile Camera Mounting Plate	Anixter	
4	RJ6 Jack	Solution Dependent	
5	RJ6 Jack Surface Mount Box	Solution Dependent	
6	Plenum Cat 6 Cable	Solution Dependent	
7	3/4" conduit w/ high flex/high noise industrial Ethernet cable for use in elevator installation	Commscope	ICAT5E2004 - Catalog# 2004
8	#6 AWG Green, Insulated, Stranded Ground Conductor	N/A	N/A
9	#10 AWG Green, Insulated, Stranded Ground Conductor	N/A	N/A
10	Appropriate Patch Cables as needed	N/A	N/A

UNCW Camera Standards Changes

Rev. 7/15/10

All Items required in the previous version concerning power supplies have been deleted. These items include the power supply, the Ditek surge suppression for power supplies, DC/DC power converter, and the wire for power supply connection.

Ditek surge suppression for each camera has been changed to a model that supports POE injection instead of “Phantom” switch POE.

Standard Camera models have been change from the previous models used by the old standards to the following models:

AXIS Model P3343-VE – used for all exterior applications

AXIS Model P3343-V – used for all interior applications

AXIS Model 209 FD-V – used in elevator installations

Adjusted wire and network jack types to be Netcom building solution dependent to match cabling in the rest of the building.

Rev. 9/22/10

Page 14 Grounding Notes

The ground wire from the TMGB to all Camera enclosures was changed from 6 AWG to 8 AWG

The ground wire from the GB in camera enclosures to Ditek components was changed from 8 AWG to 12 AWG

These changes were also made it the notes of this page.

The standard camera used for all elevator installations has changed from the Axis 209 FD to the Axis M3113-R. This change was noted in the following locations of the Camera Standards document.

Page 2 Outline

Page 7 Camera Overview

Page 12-13 Camera Datasheet

Page 28 Parts List

Rev. 10/30/12

The standard camera used for all interior installations has changed from the Axis P3343-V to the Axis P3363-V. This change was noted in the following locations of the Camera Standards document:

Page 2 Outline

Page 7 Camera Overview

Page 8-11 Camera Datasheet

Page 28 Parts List

The standard camera used for all exterior installations has changed from the Axis P3343-VE to the Axis P3363-VE . This change was noted in the following locations of the Camera Standards document:

Page 2 Outline

Page 7 Camera Overview

Page 8-11 Camera Datasheet

Page 28 Parts List

The documentation for the Ditek DTK-RM12POE has been updated to reflect the newest model. This change was noted in the following locations of the Camera Standards document:

Page 18 DTK-RM12POE Datasheet

Page 19 DTK-RM12POE Install Instructions

Page 28 Parts List

The documentation for the Ditek DTK-MRJPOE has been updated to reflect the newest model. This change was noted in the following locations of the Camera Standards document:

Page 20 DTK-MRJPOE Datasheet

Page 21 DTK-MRJPOE Install Instructions

Page 28 Parts List

The Contact information on Page 32 was amended as appropriate.

Rev. 02/17/16

Removed any reference to name ‘Business Applications’.

UNCW Camera Standards Changes

Rev. 10/21/16

Change all references of Access Control to Physical Security and Access
Remove all references to midspan injectors
Updated Personnel Page

Rev. 1/24/17

Changes made to index to reflect page number changes

Rev. 2/28/17

Changes made to Page 3, UNCW Responsibilities and Page 6, UNCW Camera Requirements regarding camera make, type and models used for UNCW projects.

UNCW Physical Security and Access

Contact Information:
Accessmgmt@uncw.edu
(910)962-3564

Please contact the Physical Security and Access Manager with any questions or concerns pertaining to this document.

SECTION 283100 - FIRE ALARM SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Automatic smoke and heat detectors.
- B. Fire alarm signaling appliances.
- C. Magnetic door holders.

1.2 RELATED SECTIONS

- A. Section 26 0123 - Building Wire and Cable.
- B. Section 26 08 00 - Commissioning of Electrical

1.3 REFERENCES

- A. 2018 North Carolina State Building Code
- B. NFPA 72: 2013 Edition of the National Fire Alarm and Signaling Code.
- C. NFPA 101 - Life Safety Code.

1.4 SYSTEM DESCRIPTION

- A. Fire Alarm System: NFPA 72, analog addressable, manual and automatic local fire alarm system, 24 VDC nominal operating voltage with non-voice horn-strobe notification.
- B. The fire alarm system shall comply with applicable provisions of the NC Building Code, and the NFPA 72. All equipment supplied shall be specifically listed for the purpose for which it is used, and installed in accordance with any instructions included in its listing.
- C. The Contractor shall furnish all parts, materials, and labor required for a complete and operating system in accordance with all applicable requirements, even if each needed item is not specifically shown or described in the project plans or specs.

1.5 SUBMITTALS

- A. Submittals are for Engineer review.
- B. Shop Drawings: Provide riser diagram, with each device and piece of equipment and system wiring diagram.
Provide floor plans with device layout, loop routing showing each loop, terminal cabinets, power booster panels, devices, connections and wire type required.
All devices, module and equipment shall be labeled with a unique number on the plans, as follows: Zone #/Addressable Loop # -- Device #.

C. Product Data: Provide electrical characteristics and connection requirements for all new and existing devices and equipment used including replacement terminal strips and terminal boxes.

D. Calculations:

1. Include a copy of system battery sizing calculations with the shop drawing submittal. Use manufacturer's battery discharge curve to determine expected battery voltage after 24 hours of providing standby power plus 15 minutes of full alarm load. Then use calculated Notification Appliance Circuit (NAC) current draw in the alarm mode to determine expected voltage drop at EOL, based on conductor resistance per manufacturer's data sheet or NEC, Table 8. Double the ohms per foot per circuit loop. Also, add any inherent voltage drop caused by the system's power supply.
2. The voltage drop at EOL shall not exceed 14% of the expected battery voltage, after the required standby time plus alarm time. Determine "worst case" voltage at far end of each NAC, by subtracting its calculated V-drop from the expected battery voltage. The result shall be no less than the minimum listed operating voltage for the alarm notification appliances used.
3. Load calculations for all power supplies and NAC booster panels shall demonstrate not to exceed 75% of maximum current load allowed.
4. All of these calculations shall be placed on a dedicated sheet of as-built drawings, for future reference by fire alarm service technicians. NAC voltage drop is to be verified during system tests.

E. Test Reports:

1. Indicate satisfactory completion of tests and inspections per Appendix A "FIRE ALARM SYSTEM CHECKLIST".

F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of products.

G. Approval of samples, cut sheets, shop drawings, and other details submitted by the contractor shall not relieve the contractor's responsibility for full compliance with project plans and specifications, unless the electrical design engineer's attention is called to each non-complying feature, by accompanying letter, and the engineer subsequently gives the contractor specific written authorization for each deviation.

1.6 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 26 0010.

B. Record actual locations of initiating devices, signaling appliances, and end-of-line devices.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 26 0010.

B. Operation Data: Operating instructions.

C. Maintenance Data: Maintenance and repair procedures.

1.8 QUALIFICATIONS

A. Installer: Company specializing in installing the products specified in this section with minimum three years documented experience and with service facilities within 100 miles of Project.

1.9 REGULATORY REQUIREMENTS

A. Furnish products listed and classified by third party agencies accredited by the NCBCC to label electrical and mechanical equipment, as suitable for purpose specified and indicated, where such listing exists.

1.10 MAINTENANCE SERVICE

A. Furnish service and maintenance of fire alarm system for one year from Date of Substantial Completion.

1.11 EXTRA MATERIALS

A. The following spare parts shall be provided with the system, each one individually packaged and labeled. Increase any resulting decimal quantities of spare parts to the next higher whole number:

- Fuses (If Used) 2 of each size in system
 - Manual Fire Alarm Boxes.....2% of installed quantity
 - Addressable Control Relays.....4% of installed quantity
 - Indoor Horns/Speakers with Strobes Lights..... 4% of installed quantity
 - Indoor Strobe-only Notification Appliances..... 4% of installed quantity
 - Monitor Modules (Addressable Interface) 4% of installed quantity
 - Isolation Modules / Isolation Bases.....4% of installed quantity
 - Addressable, Electronic Heat Detectors.....4% of installed quantity
 - Spot-Type Smoke Detectors / Sounder Bases.....6% of installed quantity
- No spares are required for projected beam, air sampling, or duct smoke detectors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. OWNER PREFERRED ALTERNATE OPA#1: The system shall be manufactured by Honeywell Notifier.

B. BASE BID: Subject to compliance with requirements the system shall be manufactured by Honeywell Notifier, Siemens, United Technologies Edwards Signaling, or Tyco SimplexGrinnell.

2.2 GENERAL

A. Provide an intelligent, addressable analog multiplex system, which shall be 24 VDC, non-coded and supervised (including control circuits). All equipment supplied shall be

specifically listed for its intended use and shall be installed in accordance with any instructions included in its listing.

- B. The fire alarm control panel (FACP) shall be the modular type, for ease of future expansion. The FACP shall have a steady "Power On" green light. Each zone shall have separate "Alarm" red lights and separate "Trouble" amber lights. Each addressable loop shall have capacity for 20% additional addresses.
- C. The FACP power supply shall have a continuous rating capable of powering all zones and functions continuously. Detection and alarm modules shall be capable of withstanding prolonged short circuits and ground faults in their field wiring without sustaining damage.
- D. The FACP shall have an alarm silence switch and Subsequent Alarm (alarm resound) capabilities. All remote annunciators shall contain these same two features.

Provide supervised bypass switches: Toggle switch in or adjacent to the FACP. If the switches are installed inside the FACP they shall be accessible from the front bezel with the cover in place. Any activated AHU shutdown defeat switch shall cause a system "trouble" indication when it's placed in the off-normal ("Bypass") position.

- 1. Supervised "AHU Shutdown Defeat" for Air Handlers.
 - 2. Supervised "Performance Sound Mute" bypass switch.
 - 3. Supervised "100% lighting level override" bypass switch.
- E. The following protective devices shall be provided by the fire alarm equipment supplier and installed by the electrical contractor:
 - 1. On AC Input: A feed-through (not a shunt-type) primary branch circuit transient arrestor such as the EFI HWM-120, Leviton OEM-120EFI, Northern Technologies TCS-HW, Transtector ACP100BWN3, or any reviewed equivalent UL Listed device adjacent to the electrical panelboard. Provide a secondary DITEK-120S20A surge protector adjacent to all line connected fire alarm equipment. Install suppressors in a listed 8"x8" enclosure and trim excess lead lengths. Wind small coil in the branch circuit conductor just downstream of the suppressor connection. Coil to be five to ten turns, about 1" diameter, and securely tie-wrapped.
 - 2. On DC Circuits Extending Outside Building: Adjacent to the FACP, and also near point of entry to outlying building, provide UL 497B listed "pi"-type filter on each leg, consisting of a primary arrestor, series impedance, and a fast-acting secondary arrestor that clamps at 30v to 40v. Some acceptable models: Simplex 2081-9027 and 2081-9028, Transtector TSP8601, Ditek DTKxLVL series, Citel America B280-24V, and Northern Technologies DLP-42. Submit specifications on others to the engineer for approval. Install suppressors in a listed 8"x8" box at the penetration point of the building envelope.
 - F. The coverage of each fire alarm zone shall be indicated at the FACP and also at any remote annunciator. Engraved labels, framed directories, and/or graphic displays may accomplish this. Label tape or handwritten labels are not acceptable.
 - G. Systems shall be provided with a separate and independent source of secondary power. Systems that report to a Remote Supervising Station shall have a minimum of 60 hours' secondary power capacity, plus five minutes of full alarm load. Proprietary and other systems require 24 hours' capacity plus five minutes of alarm load. See NFPA 72.

- H. All addressable loop controller circuits shall be Class “A”. T-taps in any fire alarm system wiring is not acceptable.
- I. The complete configuration data (site-specific programming) for the system shall be permanently stored on a computer disk or diskette and archived by the manufacturer or authorized distributor.
- J. The system shall 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. How to do this shall be included in the training required to be given to the owner’s designated personnel, and shall also be part of the written documentation provided by the fire alarm equipment supplier.
- K. Furnish any specialized equipment necessary to diagnose, program or service equipment provided.

2.3 INITIATING DEVICES

- A. Spot type detectors shall be the plug-in type, having a separate base. Each detector or detector base shall incorporate an LED to indicate alarm. The base shall have integral terminal strips for circuit connections, rather than wire pigtails. Spot-type smoke detectors shall have a built-in locking device to secure the head to the base, for tamper resistance.
- B. Manual Station: Semi-Flush mounted, non-coded type, double action manual station. Provide manufacturer’s standard backbox. They shall require the use of a key for reset.
- C. Spot Heat Detector: Combination rate-of-rise and fixed temperature, rated 135 degrees F, and temperature rate of rise of fifteen degrees F, unless otherwise noted.
- D. Spot Ceiling Mounted Photoelectric Smoke Detector: NFPA 72, photoelectric analog type with automatically adjusting sensitivity, plug-in base with integral Rate of Rise thermal element and visual indication of detector actuation, suitable for mounting on four-inch outlet box. Provide detector with common power supply and signal circuits.
- E. Spot Ceiling Mounted Ionization Smoke Detector: NFPA 72, ionization analog type with automatically adjusting sensitivity, plug-in base with integral Rate of Rise thermal element and visual indication of detector actuation, suitable for mounting on four-inch outlet box. Provide detector with common power supply and signal circuits.
- G. Each smoke detector shall continuously monitor the environment where it is installed. The sensitivity of each detector shall automatically be increased or decreased based on the local ambient conditions. The sensitivity will be adjusted as high as possible without creating false alarms. This feature shall be armed and sensitivities set prior to acceptance of the system.

2.4 SIGNALING APPLIANCES

- A. Visible signals (strobes): Shall be the flash discharge (strobe) type, UL 1971 listed, and shall comply with all current Americans with Disabilities Act (ADA) requirements for intensity. Strobes shall be enclosed in a white or clear lens with red lettered “FIRE”

stenciled on the outside. Luminous intensity as noted on the Drawings. Strobe lights installed in a single space shall be synchronized.

- B. Combination Strobe/Horn Alarm Device: NFPA 72G, surface projector type fire alarm horn. Sound Rating: 90 dB at ten feet. Alarm notification appliances, both audible and visible, shall comply with NFPA 72. The standard audible evacuation signal shall be the ANSI S3.41 three-pulse temporal pattern described in NFPA 72, except the ANSI signal shall not be used where the planned action during a fire emergency is to relocate occupants, or protect them in place, instead of immediate evacuation, provide integral strobe lamp meeting requirements of A. above.
- C. Alarm notification appliance (NAC) circuits shall be NFPA 72 Style Y (Class B). Load connected to each circuit shall not exceed 80% of rated module output and the coverage of each circuit shall not exceed three floors. NAC voltage drop during alarm shall never exceed 14% of the voltage measured across the batteries at that time. NAC voltage drop shall be calculated based on wire size, length of circuit, device load, inherent voltage loss within the FACP's power supply, etc. Contractor shall use power outage testing to verify that the NAC circuit was installed as designed.

2.5 FIRE ALARM WIRE AND CABLE

- 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 shall 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 is acceptable if only an FPL rating needed. The cable jacket color shall be red, with red (+) and black (-) conductor insulation. Unshielded cable, otherwise equal to the above, is permitted to be used where the manufacturer's installation instructions unequivocally require, or state preference for, the use of unshielded cable for all systems. In underground conduit, use Type TC or PLTC cable (PE insulated).
- B. Except as required by A and B, all other circuits in the system shall be wired with AWG 14, stranded copper, THHN/THWN conductors, installed in conduit. Color code as shown below throughout the system, without color change in any wire run:
 - Alarm notification Appliance Circuits (horns/strobes) Blue (+)/Black (-)
 - Separate 24vdc Operating Power (for equipment) Yellow (+)/Brown (-)
 - Door Control Circuits (magnet power, if from system) Orange
 - Circuits from ZAM's to Monitored Devices (AWG 14/16) ...Violet (+)/Grey (-)

2.8 ALARM COMMUNICATION TO REMOTE SUPERVISING STATION

- A. The communication methods used to transmit signals to the remote supervising station shall meet the requirements of NFPA 72 *National Fire Alarm and Signaling Code* Section 26.3. Where a DACT (Digital Alarm Communicator Transmitter) is used with telephone as the primary means of communication, then, one of the prescribed alternative transmission methods shall be employed as a redundant, secondary path. (Note, the jurisdiction with fire response authority may accept a second telephone line

in lieu of one of these secondary methods. If granted, provide SCO with a copy of the written correspondence affirming their exception allowance.).

2.9 Terminal Cabinets

- A. Terminal cabinets shall be code gauge sheet metal with a hinged cover with a key or screwdriver operated latch. Terminal strips inside these cabinets shall have pressure wire connectors of the self-lifting or box lug type.
- B. Where installed on smoke or fire doors, power failure shall cause these mechanisms to default to the egress mode with normal mechanical latching.
- C. Smoke doors are permitted to be held open by 24vdc wall/floor-mounted magnets powered by the FACP, and released upon alarm. The resulting current drain shall be included in the standby battery calculations.

PART 3 - EXECUTION

3.1 Manufacturer's instructions.

3.2 Install manual stations with the enclosure top four feet above floor. Install audible and visual signal devices 80 inches above floor or six inches below finished ceiling, whichever is lower.

3.3 Wiring

- A. All addressable loop controller (signaling line) circuits shall be fully NFPA Style 6 (Class A), with no "T" taps made. Each shall have a minimum of 20% spare addresses, for future use. Individual loops are permitted to cover more than one floor of the building.
- B. Do not splice any fire alarm system wiring except on terminal blocks. Wire nuts and crimp-on splices are not acceptable.
- C. If ceiling height less than or equal to ten feet, isolator base type initiating devices are permitted to be used. Provide as follows:
 - 1. After each 25 devices and control points on any addressable circuit.
 - 2. For each addressable circuit that extends outside the building walls.
 - 3. In or immediately adjacent to the FACP, at each end of the addressable loop. These two isolators shall be in the same room as the FACP and within fifteen feet of the FACP.
 - 4. For loops covering more than one floor, install isolator at terminal cabinet on each floor (with additional isolator[s] on any floor with over 25 addresses).
 - 5. Each isolation module shall be clearly labeled, readily accessible for convenient inspection (not above a lay-in ceiling), and shown on as-built drawings
- D. Install all wiring in metal conduit except as noted below. All conduit shall be concealed in walls, in floors or above ceilings where possible. PVC conduit is permitted to be

used underground, in concrete, and in exterior locations subject to severe corrosion (such as coastal facilities).

- E. Provide permanent wire markers on all wiring at all points where wiring is accessible such as outlet or pull boxes, termination cabinets, etc. The wire identification scheme shall be consistent throughout, i.e., the same conductor shall have the same identification number or code at all points where that wire is marked.
- F. 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 Megohms, verified with a megger.
- G. Provide an engraved label inside the FACP indicating the location and identification of the panelboard and branch circuit supplying 120 VAC to the system.
- H. Mount end-of-line device box with last device or separate box adjacent to last device in circuit.
- I. Automatic Detector Installation: Conform to NFPA 72. The Electrical Contractor shall furnish the duct detector housings and sampling tubes to the HVAC Contractor for installation. The housings shall be installed per the manufacturer's recommendations, at least three duct widths from duct fittings, such as tees, ells, wyes, etc., where possible. Otherwise mount the housings and sampling tubes as far from duct fittings as possible. The Electrical Contractor shall provide 12"x12" inspection doors for servicing sampling tubes. Install detectors inside housings and run necessary conduit and wire to the detectors.
- J. Conduits that penetrate outside walls from air-conditioned space shall be sealed to prevent condensation with duct-seal or similar material.
- K. 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 are not 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 (see L).
- L. Mount a framed copy of the alarm zone chart and basic operating instructions next to the FACP, and beside any remote annunciator panels. The zone chart shall show:
 - 1. Floor plan of each floor in the building.
 - 2. All fire alarm and detection devices, with zone and device numbers indicated.
 - 3. Color-coded zone layouts.
- M. Detector Installation
 - 1. 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.
 - 2. Spot type smoke detectors mounted within twelve feet of a walking surface shall have their built-in locking device activated.
 - 3. Do not mount any spot type smoke detectors within three feet of supply air diffusers.
 - 4. Unless suitably protected against dust, paint, etc., detectors shall not be installed until the final construction clean up is completed. Contaminated detectors shall be

replaced at this contractor's expense. Covers supplied with smoke detector heads do not provide protection against heavy construction dust or spray painting. They are suitable only during final job cleanup or touch up operations.

5. Identify all detectors by assigning each a unique number on the plans, as follows: (Zone #/Addressable Loop # -- Device #). This number shall be put on the shop drawings, as-built plans, and be permanently mounted adjacent to the detector, or affixed to its base, so as to be readable standing on the floor below without having to remove the smoke detector.
 6. RAILS and a keyed or magnet-operated Alarm Test switches shall be installed in the nearest corridor or public area and identified by an engraved label affixed to the wall. Mounting height shall be 7'-6" AFF.
 7. Mark the direction of airflow on the duct at each duct detector location.
 8. The air handling unit shutdown signal shall originate at the FACP. Do not shut down AHUs directly from duct-mounted detectors.
 9. 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 Engineer.
 10. Duct detector sampling tubes shall extend the full width of the duct. Those over 36 inches long shall be provided with far end support for stability.
 11. Provide a gasketed, hinged or latched duct access panel, 12x12 inches minimum, for sampling tube inspection and cleaning NTE 36" from the sampling tube on the supply (pressure) side of the sampling tube. Indicate airflow direction on the duct, adjacent to the detector, using stencil or permanent decal.
- N. Addressable interface modules (used for all contact type initiating devices) shall be located in a conditioned environment, which does not exceed listing test parameters, to prevent failures due to temperature/humidity extremes. They may be permitted to serve more than one contact device in the same limited area, subject to approval of the Engineer. Addressable interface modules and relays shall be wall mounted. Ceiling mounted devices are not acceptable.
- O. The FACP and all other control equipment locations, including any transponders, sub-panels, and booster power supplies, shall be protected by a photoelectric type smoke detector located within fifteen feet of the equipment (measured horizontally).
- P. Notification Appliance Circuit booster power supplies shall have a battery backup and 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 shall also be monitored for integrity.
- Q. Junction boxes shall be painted red inside and out prior to pulling the wire. Those installed in finished areas are permitted to be painted outside to match the finish color.

3.4 PROGRAMMING, TESTING, AND CERTIFICATION:

- A. 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 compliment of spare parts for the system. The technicians who do this are required to be trained and individually certified by the manufacturer, for the FACP model/series being installed. This training and certification shall have occurred within the most recent 24 months. Copies of the certifications shall be part of the contractor's submittal to the engineer, prior to installation.

- B. When programming the system, activate the automatic drift compensation feature for all spot-type smoke detectors. Whether or not to activate the alarm verification feature for such detectors is to be determined by the design engineer/owner's representative. In the absence of clear guidance on the latter, do not use alarm verification.
- C. Set spot-type smoke detector sensitivities to normal/medium, unless directed otherwise by the design engineer/owner's rep.
- D. Print a complete System Status and Programming Report, after the above steps have been done. This shall include the program settings for each alarm initiating device and the current sensitivity of each analog addressable smoke detector. See E.
- E. The manufacturer or authorized distributor shall 100% test all site-specific software functions for the system and then provide a detailed report or checklist showing the system's operational matrix. This documentation shall be part of the "System Status and Programming Report" described in D.
- F. Upon completion of the installation and its programming, the fire alarm 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, etc. The engineer shall be notified in advance of these 100% tests, to permit witnessing them if desired.
- G. The contractor shall fill out and submit the following documentation to the owner, through the engineer, prior to the Engineer's system acceptance inspection:
 - 1. The NFPA 72-2013, "Record of Completion" form per chapter 7. Use this form (no substitutes) to detail the system installation and also to certify that: (a.) It was done per Code, and (b.) The Code-required 100% test was performed by the contractor. If a representative of the AHJ, owner, or engineer witnesses the tests, they sign the last line of the form to signify that fact only (annotating the form as needed).
 - 2. For buildings with a smoke control or smoke purge system, an HVAC balance report, in the smoke control / smoke purge mode.
 - 3. The System Status and Programming Report described in D.) This shall be generated on the day of the system acceptance inspection.
- H. After completion of the 100% system test per E and submission of documentation per G, the contractor is to request the engineer to set up an inspection. The system shall operate for at least two days prior to this inspection.
- I. The fire alarm system will be inspected, with portions of it functionally tested. This will normally include the use of appropriate means to simulate smoke for testing detectors, as well as functionally testing the system interface with building controls, fire extinguishing systems and any off-premises supervising station. Operation of any smoke removal system will be checked with smoke candles or by other means. This statistical (sampling) inspection is intended to assure that the contractor has properly installed the system and performed the 100% operational test as required by NFPA 72. The contractor shall provide two-way radios, ladders, and other materials needed for testing the system (smoke candles, other smoke source, etc.).

3.5 DOCUMENTATION, OWNER TRAINING, AND SPARE PARTS:

- A. The contractor shall provide to 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 in the system, plus equipment terminal numbers, (2) Manufacturer's detailed maintenance requirements, (3) Technical literature on all control equipment, isolation modules, power supplies, alarm/supervisory signal initiating devices, alarm notification appliances, relays, etc, (4) The as-built "calculations" sheet referenced in paragraphs 1.5.
- B. Complete configuration data (site-specific programming) for the system shall be stored on electronic media and archived by the fire alarm system manufacturer or authorized distributor. A diskette or CD copy of this data shall be submitted to the engineer for transmission to the owner on the day the system is commissioned.
- C. The manufacturer, or authorized distributor, shall 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.
- D. 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" shall either be kept at/in the FACP, or its location shall be permanently indicated there by engraved label.
- E. Provide an engraved label inside the FACP identifying its 120 VAC power source, as follows: Panelboard location, panelboard identification, and branch circuit number.
- F. The manufacturer's authorized representative shall instruct the owner's designated employees in operation of the system, and in all required periodic maintenance. A minimum of 2 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.

END OF SECTION 283100

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FIRE ALARM SYSTEM CHECK LIST



BUILDING NAME: _____ LOCATION: _____

DESIGNER: _____ INSTALLER: _____

INSPECTION BY: _____ DATE: _____

Preparation for Acceptance Test

- ☐ Fire authorities have been notified of the system test. Also notify any location where alarms are transmitted. DO NOT ROLL FIRE TRUCKS BY ACCIDENT. All building occupants have been clearly notified of the system test.

All required documents are on site for the SCO inspection and review.

- ☐ A copy of the project plans and specification
- ☐ A copy of the contractor's approved shop drawings including:
 - o cut sheets
 - o battery size calcs
 - o Matrix
 - o plans
 - o Voltage drop calcs
 - o Training Certificates
- ☐ A copy of the Fire Alarm system "as built" drawings showing the routing of circuits installed
- ☐ Final NFPA 72 "Fire Alarm System Record of Completion" form
- ☐ A copy of the System Operation Matrix, giving the FACU response for each initiating device input, has been provided by the fire alarm installer to facilitate testing.
- ☐ A copy of the sensitivity report
- ☐ A copy of the printout generated by the 100% device testing

NFPA 72 "Record of Completion"

- ☐ **NFPA 72 "Record of Completion" Form, filled out, with all signatures and at FACU**
- ☐ Appropriate year of form is used per year of Building Code permit
- ☐ Appropriate chapters must be indicated (see chapter list in the reference section of document)
- ☐ The manufacturer's authorized distributor (by definition the "installer") who made final connections at the FACU and programmed the system gave the owner and AHJ advance notice of the required 100% operational tests, so they could elect to attend.
NOTE: The required 100% testing cannot properly be done by a single technician without a helper, even if the FACU has Walk-Test or an equivalent feature. Query the tech on how testing was performed.
- ☐ Signatures on the form must match the typed/printed names and each section must be complete. Do not accept a company name in place of the responsible individual. The individual must have a certificate. NOTE: If part or all of the testing was witnessed by a representative of the AHJ, the final line of the form is signed to indicate that. (SCO design contracts give that responsibility to the electrical PE.)
- ☐ Verify the technician who programmed the alarm system was trained and certified by the manufacturer, for the specific FACU model being installed, within the past 2 years. (A copy of the cert. should have been submitted with the Shop Drawings.) NICET Level III certification will extend this to 36 months.

REVIEW THE FOLLOWING ITEMS FROM THE SHOP DRAWING SUBMITTAL:

- ☐ Contractor has submitted battery calculations to the designer, verifying the system meets applicable capacity requirement of NFPA 72. The minimum endurance is 24 hours plus 5 minutes of alarm load. See the specification for additional requirements imposed by the AHJ.
- ☐ Battery sizing calculations verifying adequate Amp-Hour rating, indicating that the worst case NAC voltage on battery is within alarm notification appliance listing, and that NAC alarm load voltage drop at EOL does not exceed **14%** of battery voltage.
- ☐ Notification Appliance Circuit (NAC) calculated current draw, demonstrating that none exceed 80% of rated module output.
- ☐ If system is the Emergency Voice/Alarm type, amplifier load calculations.
- ☐ Copy of factory training certificates for technicians who programed the system.

REVIEW THE FOLLOWING ITEMS FROM 100% Test:

- ☐ **System Status and Programming Report, which includes the following 3 elements:**
 - ☐ Program settings for each alarm initiating device
 - ☐ Current sensitivity reading of each smoke detector
 - ☐ System operational matrix, giving response for each alarm input

- ☐ **If building has smoke purge system, an HVAC balance report in purge mode**
- ☐ **Two bound copies of the following information on the system (may be combined):**
 - ☐ Manufacturer's technical literature (cut sheets) on system components
 - ☐ Required maintenance schedule on system, to comply with NFPA 72
 - ☐ As-built drawings with loop #'s, device addresses, equipment terminals

COMPARE DOCUMENTS TO INSTALLATION

Shop drawings calcs:	NFPA 72 says:	Installed size is:
FACU batteries ____ AHr ____ @ ____ V each	____ AHr ____ @ ____ V each	____ AHr ____ @ ____ V each
NAC batteries ____ AHr ____ @ ____ V each	____ AHr ____ @ ____ V each	____ AHr ____ @ ____ V each
DACT batteries ____ AHr ____ @ ____ V each	____ AHr ____ @ ____ V each	____ AHr ____ @ ____ V each
SLC loops _____ class _____	_____ class _____	_____ class _____
NAC Circuits _____ class _____	_____ class _____	_____ class _____

Check Fire Alarm Control Panel(s)

- ☐ **VERIFY SYSTEM IS IN TEST MODE AND THE FIRE TRUCKS WILL NOT ROLL.**
- ☐ Operating instruction summary is framed and mounted at (or inside) the FACU.
- ☐ Green grounding wire is bonded to FACU cabinet, and also connected to designated terminal on motherboard (if any).
- ☐ AC Power
 - Branch circuit to FACU does not share conduit with 24vdc alarm initiating circuits or notification appliance circuits.
 - Circuit breaker(s) serving FACU (and associated equipment) have lock on clips and red dot at breakers. (Some electricians will not paint the handle to avoid damage to the breaker)
 - Placard inside FACU gives the following info on this circuit: **Panelboard location, panelboard identification, and branch circuit number** (The same applies to SNAC panels and any other system control equipment)
 - Surge arrestor model listed in project spec (feed-through type with "pi" configuration) is installed at electrical panelboard, on the 120vac branch circuit to FACU. Arrestor leads are trimmed as short as practical. See attached wiring diagram for more info.
- ☐ Fire alarm control unit (FACU) is powered up and clear of alarms, supervisory signals, and trouble conditions.
- ☐ Have ground fault put on any alarm initiating or notification appliance (horn-strobe) circuit. FACU must indicate "ground" and general "trouble." Verify this ordinary "trouble" signal is not sent to any Remote Supervising Station.
- ☐ Record battery size and verify date of installation is marked on each battery (Marking of the date of manufacture of the battery is a code requirement – so you will find 2 dates)
- ☐ Have technician disconnect a battery lead and verify the FACU indicates a local trouble signal within one minute of that action.
- ☐ Reconnect battery, **then** turn off 120vac. Batteries should measure approx. 13 volts, and differ ≤ 0.4 volt. (Also check batteries in any booster power supplies.)
- ☐ If system is connected to Remote Supervising Station, verify the FACU did **not** transmit AC Power Failure "trouble" signal, as it was not maintained for 1-3 hours.
- ☐ Have technician confirm FACU is programmed to send an AC power failure trouble signal to Remote Supervising Station if power loss continues for 1 hour minimum to 3 hours maximum. Also, verify that no other types of "trouble" signals are reported.

- ☐ The FACU and any transponders, sub-panels, DACT and "ADA" booster power supplies must be protected by a smoke detector within 15 feet of their location, measured horizontally, as required by Code (NFPA 72).
- ☐ Addressable loop controller circuits are Class "A", with isolation modules at FACU on the outgoing and return loop, after each 25 addressable devices (max) on the loop, and (if ≤ 25 devices) at midpoint.
 - Have the technician apply a short circuit on the SLC loop. This will force two isolation modules to clamp. The test is to verify their operation and device count between the two that clamp.
 - With AC power off, there will be multiple troubles on the system. The total count will increase during this test. Exclude the count prior to the short.
 - On retrofit and repair work where the AHJ has approved the use of a class B SLC wiring design the isolation modules will not be installed.
 - Verify the number of devices between Isolation modules meets the specification requirement.
- ☐ While on battery power, initiate Alarm. Batteries should remain at 12+ volts each, but dropping slowly. Let alarm continue during next step.
- ☐ Verify the Notification Appliance Circuit (NAC) voltage drop at the EOL is ≤ 3 volts. Do this separately for each NAC. Look at the shop drawing to find the worst case scenarios when spot checking at a final.
- ☐ Silence the alarm and verify that any Remote Supervising Station has received a fire alarm signal. Reset the FACU and verify the Station receives a subsequent "restore" signal, indicating the alarm condition has been cleared.
- ☐ Verify requirements on wire type and gauge were followed and that the color code for circuits is proper throughout the system. (Review specifications and shop drawing requirements.).
- ☐ Have installing technician demonstrate that the system is programmed so all **spot-type** smoke detectors have automatic drift compensation and FACU will indicate when prescribed sensitivity limits are reached or exceeded.
- ☐ If system has provisions for "alarm verification" algorithm, arm it only if needed for the environment. Do **not** apply it to multi-sensor or multi-criteria smoke detectors.
- ☐ If any addressable control relays are installed, verify their contact ratings are suitable for connected load. (Some are rated for resistive loads only.) Also, if they require separate 24vdc power for operation, verify the circuit is electrically supervised. Compare their installed location to the design intent.
- ☐ All field wiring in the system has wire markers where landed at the FACU, and also in the terminal cabinet(s) on each floor of multistory buildings.
- ☐ If system uses an LED "zone" annunciator to provide a quick visual overview of the fire scenario for responding public safety personnel (general fire area and type of alarms), a framed directory or typed/engraved LED labels provide clear information on "zone" (area) boundaries and the type(s) of alarms (i.e., smoke, waterflow, etc.)
- ☐ During the walk through of the site verify that there are **no** splices in the system wiring other than at terminal blocks which are installed in identified terminal cabinets. "Wire nuts" and butt splices are not permitted on new work.
- ☐ All circuits are properly and securely terminated. Approved terminal fittings are used for any stranded wire terminations at screw posts that lack pressure connectors.

- ☐ Initiate alarm on a representative sample of devices by operating manual fire alarm box, blowing smoke into detector, flowing water from sprinkler system inspector's test station, etc., except do not test any non-restorable, fixed temperature heat detector. (get total counts from 72 form)
 - ☐ Photo smoke ____/____ ☐ Duct smoke ____/____ ☐ Heat detector ____/____
 - ☐ Ionization smoke ____/____ ☐ Other detector ____/____ ☐ Flow switch ____/____
 - ☐ Pull Station ____/____ ☐ tamper switch ____/____ ☐ ____/____
- ☐ For each device tested have FACU operator read out the FACU display and the LED display. (Radios are very helpful at this point.) There should be a clear indication of device type, device number and location for each device tested.
 - Individual detectors of all types shall be identified on their bases (Loop # -- Device #), in sequence on the loop from the FACU
- ☐ While spot testing devices in the facility verify operation of audible-visible alarm notification appliances.
 - Audible alarm devices must be 15 dBA above normal ambient sound level in all occupiable areas of building. (Use meter if in doubt.)
 - Indoor strobes must flash 60-120 times/minute and those installed in a single space (room, corridor, etc.) must be synchronized and remain synchronized throughout the test.
- ☐ Also verify HVAC shutdown and closure of (any) smoke doors. These functions must be done by the FACU, rather than by integral smoke detector relay contacts.
 - Shutdown must occur within 20 seconds, except gas pack units can be arranged for up to 60 seconds delay before the fan stops, to prevent heat exchanger damage.
 - After verifying the HVAC shutdown is operational it is acceptable to activate the HVAC bypass to avoid excessive restarting of large air handler systems.

ELEVATORS

- ☐ Elevator control key and technician must be on site for the following tests to take place
- ☐ Elevator lobby detectors must be within 21 feet of each elevator door
- ☐ Test detector(s) located at elevator lobby that will initiate elevator recall
 - Verify recall to a primary floor
 - Verify recall to alternate floor
 - Verify illumination of "Fire Hat"
- ☐ Test detector(s) located in shaft & elevator machine room
 - Verify recall to designated floor
 - Verify flashing illumination of "Fire Hat"
- ☐ Heat Detectors installed in a shaft or machine room and used for shunt trip activation shall be located within 2 feet of each sprinkler head. (Verify heat setting is less than sprinkler setting per code req.)

SPRINKLER SYSTEMS

- ☐ If a sprinkler system is present, check the operation of the waterflow alarm switches by flowing water from Inspectors Test connection(s), unless dry pipe system. Alarm sounds in 20-45 seconds and any outside water motor gong rings properly in ≤ 300 seconds.
- ☐ Inspectors Test Connection flow is limited to 1/2" stream (or actual orifice size of the sprinklers in the system, if different) by a valve or sight glass marked accordingly, or by a sprinkler head (minus deflector) mounted at discharge. NOTE: If a pipe union with an internal restrictor plate is used for this purpose, have the sprinkler contractor take at least one apart for inspection, to verify the orifice size.
- ☐ Close any electrically supervised sprinkler control valves to verify supervisory alarm at FACU within 2 turns of control wheel or, for Post Indicator Valve (PIV), within 1/5 of valve control mechanism's travel distance. Then reopen to verify "restore" signal.
- ☐ If dry pipe or pre-action sprinkler system, have contractor demonstrate waterflow alarm functions, and that both high and low air pressure are supervised as required.
- ☐ Each fire extinguishing system, such as in a kitchen hood, is connected to give building fire alarm. Have contractor demonstrate that this functions properly, by manually operating the monitored switch, without releasing extinguishing agent.

NOTE: Kitchen hood fire extinguishing system activation must shut off the gas, if used, and, for wet chemical type, also operate a shunt trip breaker to shut off the electric power to all protected appliances under the hood. The exhaust fan(s) keep running but the make-up air must shut down. These functions are to be done directly by fire extinguishing system, rather than the FACU, since it is not appropriate to cut off the gas supply or to operate the shunt trip for other types of alarms not involving the kitchen hood extinguishing system (e.g., smoke detectors, fire alarm boxes, etc.).

- ☐ Verify that fire alarm system monitors power to any fire suppression system shunt trip breakers. (Look for kitchen hood systems and sprinklered elevator spaces.)
- ☐ If remote alarm annunciator in building, verify proper operation, including the audible "Trouble" signal. Check its "Lamp Test" and "Trouble Silence" features, if provided.
- ☐ If a Fire Pump is part of the sprinkler system – verify that NFPA 20 certification was provided and testing has been successfully completed

OTHER SUPPRESSION SYSTEMS

- ☐ Pre-action suppression system – If installed and if it has an independent control panel it will require a separate NFPA 72 certificate from the building Fire Alarm Panel
- ☐ Dry Chemical suppression system – If installed and if it has an independent control panel it will require a separate NFPA 72 certificate from the building Fire Alarm Panel

PROPER INSTALLATION OF DEVICES

- ☐ Verify all dust covers have been removed. If still installed how was the 100% test done?
- ☐ Spot type smoke detectors shall not be located within 3 feet of a supply or return air diffuser, nor in a strong air stream from a supply diffuser at any distance.
- ☐ Wall-mounted smoke detectors must be installed between 4 and 12 inches from the ceiling (measured to the nearest edge of the detector), as required by NFPA 72.
- ☐ Wall mounted detectors shall not have wall-mounted luminaires or other obstructions below.
- ☐ Ceiling mounted smoke detectors shall be at least 4 inches from a wall or ceiling obstruction.
- ☐ All smoke detectors are analog addressable model(s) having a separate plug-in head, concealed locking device, and terminal strips for circuit connections.
NOTE: Snap-ring mounted models with removable terminal strip plug for connection to loop conductors do not comply with the intent of this requirement and typically do not have a locking device to deter tampering.
- ☐ Verify that the isolation modules and addressable initiating device interface modules are located in a conditioned space (not attics, boiler rooms, unheated warehouses, damp locations, outside corridors, parking decks, etc.). Exception: Any devices that are specifically listed for the ambient conditions expected (or likely) in the area where installed.
- ☐ Verify that all detectors, modules and pull stations installed outside or in non-conditioned spaces are listed for use at the both ends of the expected temperature. (eg Typically addressable pull stations are not listed for use in parking decks because the low end is 32 degrees.)
- ☐ Verify that any strobes in walk-in coolers or freezers are listed for that environment or provided with heated Lexan enclosures for which they are specifically listed.
- ☐ Check any outside alarm bells and strobes for operation. Verify outside strobe is the weatherproof type with at least 100cd output, double flash, with clear lens.

DUCT SMOKE DETECTORS

- ☐ Intake tube has its holes /slots facing into the air stream, and a stopper installed to seal its far end.
- ☐ If the tube is over 36 inches long, the far end must be supported for stability. If support is provided by extending the intake tube through the far side of HVAC duct (best for inspection, cleaning, testing), the duct penetration must be sealed.

- ☐ Each duct smoke detector has a Remote Alarm Indicator Light (RAIL) in nearest corridor or other public space. (Because addressable, test switch is **not** required.)
- ☐ At each duct detector a 12"x12" minimum access door, hinged or latched type, is provided to facilitate sampling tube inspection and cleaning.
- ☐ Air flow direction is permanently indicated on the duct by stencil or decal, to help assure the sampling tubes are installed and maintained in the correct orientation.

DACT

- ☐ **Verification of the dial out ability** or other means of remote alarm signaling
- ☐ Verify that DACT it is connected and functioning properly, to transmit fire alarm, supervisory, and trouble signals as separate, distinct events.
- ☐ Verify two phone lines are present and labeled when sprinkler is installed.
- ☐ Verify that DACT is programmed for 24-hour silent test call to the supervising station.
- ☐ Verify each type of signal is properly received and coded at the receiving station. (Supervisory signals include sprinkler valve tamper, fire pump off-normal, hi-low air pressure, etc.)
- ☐ Inspector is to personally talk to someone at the receiving station to verify alarm receipt

PRINTER

- ☐ The specification should require that systems with more than 100 addressable points, or in a building that exceeds 3 occupied floors or 60,000SF, an event printer is to be provided which uses ordinary non-thermal paper. In a high rise building, the printer must be FACU-monitored and on a generator-supported circuit.
 - NOTE: Printer does not have to be adjacent to FACU and, except for high rise buildings, does not have to be electrically supervised.

OTHER SYSTEMS

- ☐ For dormitories there will be special testing required for the sounder bases and the handicapped notification which uses higher candela strobes. Even if system is dual event it must dial out on 1st alarm.
- ☐ For institutions check for keys to the lockable pull stations if they are installed.
- ☐ Where smoke "sniffer" systems are used - create a test procedure with the help of the designer.
- ☐ Where beam detectors are used verify they are not on walls subject to movement and are not subject to direct sunlight.
- ☐ Where smoke evacuation &/or AHU bypass is used verify that the panel can be locked and operation limited to qualified people.
- ☐ Mass Notification systems require special procedures and testing to verify proper operation.

TRAINING ETC

- ☐ Verify that the Owner's designated personnel have received training in system operation: How to interpret, silence, and reset FACU signals, how to obtain service, etc.
- ☐ Verify that when required by specification, owner's personnel have received more thorough, detailed training in system troubleshooting and repair, plus installation manuals and other documentation, as applicable. (This is standard for the UNC-Chapel Hill campus.)
- ☐ Contractor has provided electronic copy of system's site-specific programming. (CD, flash drive)
- ☐ Contractor has provided spare parts in accordance with the specification for the project.

REFERENCE INFORMATION TO ASSIST SYSTEM INSPECTION

After the required 100% system operational test the contractor submits a "final" copy of NFPA 72* "Fire Alarm System Record of Completion" form. This form is to verify the proper operation of all (restorable) alarm initiating devices, audible and visible notification appliances, and other system functions including HVAC control, closure of smoke doors and dampers, pressurization fans, remote signaling, etc.

*Use only the NFPA form, or an identical reprint. The NFPA 72 form will vary with the year the project was permitted. The year required should be listed in the project specification.

NC Building Code, Chapter 35 Referenced Standards set the NFPA 72 version requirements

Projects permitted under NC Building Code 2002 - NFPA72 1999

Projects permitted under NC Building Code 2006 - NFPA72 1999

Projects permitted under NC Building Code 2009 - NFPA72 2002

Projects permitted under NC Building Code 2012 - NFPA72 2007

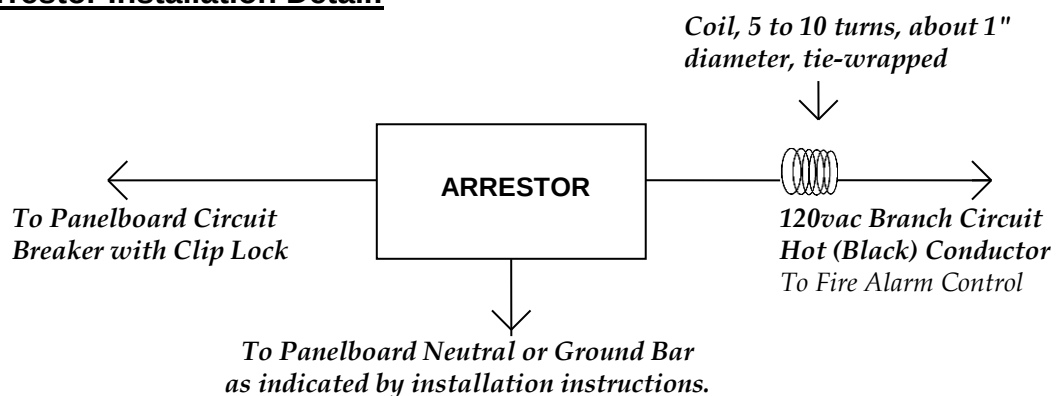
NFPA 72 Chapters (note they vary by version year)

(1999) Chapters: 1-Fundamentals, 2-Initiating Devices, 3- Protected Premises, 4-Notification Appliances, 5- Supervising Station FA system, 6- Public FA reporting systems, 7-Inspection and Testing, 8-FA for Dwelling units, 9-Reference publications_____

(2002) Chapters: 1- Administration, 2-Referenced Publications, 3- Definitions, 4- Fundamentals, 5- Initiating Devices, 6- Protected Premises, 7- Notification Appliances, 8- Supervising Station FA system, 9- Public FA reporting systems, 10- Inspection and Testing, 11- Single and Multiple Station & Household_____

(2007) Chapters: 1- Administration, 2-Referenced Publications, 3- Definitions, 4- Fundamentals, 5- Initiating Devices, 6- Protected Premises, 7- Notification Appliances, 8- Supervising Station FA system, 9- Public FA reporting systems, 10- Inspection and Testing, 11- Single and Multiple Station & Household_____

Transient Arrestor Installation Detail:



NOTE: Securely mount transient arrestor in accessible junction box or other proper metal enclosure adjacent to the panelboard, and provide engraved label indicating its location

REFERENCE INFORMATION TO ASSIST SYSTEM INSPECTION

Wiring: All addressable system wiring shall be color coded in accordance with following scheme, which must be maintained throughout system, without color change in any run:

- Addressable Loop Controller Circuits: Cable per spec, with Red Jacket and Red(+) and Black(-) Conductors
- One-way Voice/Alarm and Two-way (Fireman's Telephone): Wire per specifications

The following circuits use THHN / THWN conductors, of the size and color indicated:

- Alarm Notification Appliance Circuits: AWG 14, Blue(+) and Black(-) conductors
- AHU Shutdown, Elevator Capture, other control functions: These are now done by addressable control relays on the loop. The relays may require separate power circuits, in which case use AWG 14 conductors, with Yellow (+) and Brown (-) color code. **NOTE: Check any power circuits to addressable relays for electrical supervision by disconnecting 1 lead.**
- Circuits that power door magnets from the FACU or SNAC panels: AWG 14, Orange
- Circuits from ZAM's to monitored initiating devices: AWG 16 or 14, Violet (+), Grey (-)
- NOTE: Most manufacturers either require or recommend low capacitance, twisted, shielded pair cable for Signaling Line Circuits (addressable loops). All shielded cable must have the grounded "drain" wire maintained continuously around the loop. If unshielded cable was used, verify that the manufacturer's installation instructions require or state a preference for use of unshielded cable. For addressable system retrofit when a non-addressable system had previously been in service, if existing single-conductor wiring from the old system was used (sometimes done if in fine condition, properly color coded, with terminal strips, etc.), verify that the manufacturer's installation instructions do not require the use of twisted pair conductors or low capacitance cable and the installer also agreed to replace the existing fire alarm system wiring if unsatisfactory performance is caused by its re-use (e.g., spurious signals, cross-talk, etc.).

Spares: Provide the following spare parts with the system, each individually packaged and labeled. For multi-building project calculate separately for each building with FACU:

- Fuses (If Used).....2 of each size in system
- Manual Fire Alarm Boxes.....2% of installed quantity
- Addressable Control Relays.....4% of installed quantity
- Indoor Horns/Speakers with Strobes Lights.....4% of installed quantity
- Indoor Strobe-only Notification Appliances.....4% of installed quantity
- Monitor Modules (Addressable Interface).....4% of installed quantity
- Isolation Modules / Isolation Bases.....4% of installed quantity
- Addressable, Electronic Heat Detectors.....4% of installed quantity
- Spot-Type Smoke Detectors / Sounder Bases.....6% of installed quantity

NOTE: Increase decimal quantities of all spare parts to next higher whole number when calculating.

NOTE: No spares are required for projected beam, air sampling, or duct type smoke detectors.

SECTION 310500 - EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Excavating and backfilling for utility trenches.

1.2 DEFINITIONS

- A. Backfill: Soil material used to fill an excavation.
 - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Course placed between the subbase course and hot-mix asphalt paving.
- C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
 - 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions changes in the Work.
 - 2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.
- G. Fill: Soil materials used to raise existing grades.
- H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- I. Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- J. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

- K. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.3 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Engineer and then only after arranging to provide temporary utility services according to requirements indicated.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: AASHTO M 145 Soil Classification Groups A-1, A-2-4, A-2-5, and A-3, or a combination of these groups; free of rock or gravel larger than 2 inches (50 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Soil Classification Groups A-2-6, A-2-7, A-4, A-5, A-6, and A-7 according to AASHTO M 145, or a combination of these groups.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.
- E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.
- F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.
- G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.
- H. Drainage Course: Narrowly graded mixture of washed crushed stone or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.

2.2 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface.
- C. Protect and maintain erosion and sedimentation controls.

3.2 EXCAVATION

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
 - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.3 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit, unless otherwise indicated.
 - 1. Clearance: 12 inches (300 mm) each side of pipe or conduit.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
 - 1. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material, 4 inches (100 mm) deeper elsewhere, to allow for bedding course.

3.4 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi (17.2 MPa), may be used when approved by Engineer.
 - 1. Fill unauthorized excavations under other construction or utility pipe as directed by Engineer.

3.5 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.6 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Backfill trenches excavated under footings and within 18 inches (450 mm) of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Division 16 Section 16045 "Electrical Related Work"
- D. Provide 4-inch- (100-mm-) thick, concrete-base slab support for piping or conduit less than 30 inches (750 mm) below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches (100 mm) of concrete before backfilling or placing roadway subbase.
- E. Place and compact initial backfill of subbase material, free of particles larger than 1 inch (25 mm) in any dimension, to a height of 12 inches (300 mm) over the utility pipe or conduit.
 - 1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- F. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- G. Install warning tape 6 inches (150 mm) below finished grade.

3.7 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
 - 1. Under grass and planted areas, use satisfactory soil material.
 - 2. Under walks and pavements, use satisfactory soil material.
 - 3. Under steps and ramps, use engineered fill.
 - 4. Under building slabs, use engineered fill.
 - 5. Under footings and foundations, use engineered fill.

3.8 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
 - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Remove and replace or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.9 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inches (200 mm) in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
 - 1. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.

3.10 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 - 1. Lawn or Unpaved Areas: Plus or minus 1 inch (25 mm).

3.11 SUBBASE AND BASE COURSES

- A. Place subbase and base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase and base course under pavements and walks as follows:
 - 1. Shape subbase and base course to required crown elevations and cross-slope grades.
 - 2. Compact subbase and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.12 DRAINAGE COURSE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.

- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
 - 1. Place drainage course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
 - 2. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.13 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
- C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Engineer.
- D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable.
- E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.14 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.15 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 310500

SECTION 310523 - TRENCHLESS UTILITY INSTALLATION

PART 1 - GENERAL

1.1 Summary

- A. Definition - Horizontal Directional Drilling (HDD), also known as Directional Boring and Pilot Tube Microtunneling or short microtunneling are defined in this section for sizes 1-1/2" through 6" and larger nominal internal diameter pipe, conduit and conduit sleeves. This system is a two or three stage system, which allows both trenchless guided installations of pipes. Pipes in this section refer to UL listed Sched. 40 HDPE conduits for direct installation of conductors and non-UL listed Sched. 40 HDPE conduit sleeves, which allow installation of UL listed conduit within the sleeve. Conductors are not permitted to be installed directly in non-UL listed conduits.
- B. The size of the installed conduit shall not exceed the maximum fill ratio mandated by the national electrical code and be coordinated with the lighting system manufacturer.
- C. The size of the sleeves shall be sufficient in size to accommodate conduit sizes installed coordinated with the lighting system manufacturer.
- D. All conduit sleeves (pipes) and conduits shall terminate in underground pullboxes or at the lighting controller.
- E. The Pilot Tube Microtunneling boring machine uses a remote controlled, laser or theodolite guidance system to maintain specified line and grade, a jacking system is used for thrust and mechanical drive which creates torque to both the pilot tube and the augers used for soil removal.

Contractor Responsibility:

Verification of existing underground utilities and repair of any accidental damage of existing utilities as a result of this work.

When using this method of construction, the Contractor shall be responsible for the orderly and timely progression of work. If obstructions with a maximum lateral dimension of less than one foot are encountered, the Contractor shall be capable of advancing past said obstructions either by this method or by open trench method. No additional compensation shall be provided for such work.

Pipe used on this project within the defined limits of work for Pilot Tube Microtunneling shall be designed by the Contractor's Professional Engineer. See Part II for design criteria. The pipe manufacturer's engineer is acceptable.

Design of vertical shafts, excavations and all other features as required to provide the completed pipe installation.

1.2 Limits of Work – Extend of Pilot Tube Microtunneling is defined on Plans and Drawings.

1.3 Contract Method

1.4 Design and Performance Requirements

- A. Pilot Tube Microtunneling Machine - The system utilized shall be either a two phase system or a three phase system as described below and shall consist but not be limited to the major components listed below.

1. Major Components

- a. Line and Grade Control System - The control system shall include but not be limited to a theodolite, lighted target, camera, and monitor screen.
- b. Jacking Frame - The jacking frame shall possess adequate strength to advance the pilot tube, the enlargement casing and the string of pipe sleeve from the drive shaft to the receiver shaft. The jacking force shall be easily regulated down to the safe working load rating of the pipe. The frame shall develop a uniform distribution of jacking forces on the end of the pipe. The auger motor shall possess adequate torque to steer the pilot tube and adequate torque and speed to effectively auger the excavated material from the face of the bore to the drive shaft.
- c. Pilot Tube - The pilot tubes shall be constructed of steel in rigid but short sections to accommodate the small drive and receiver shafts. The tubes shall rigidly connect to each other, the steering tip and the enlargement casing and have a clear inside diameter large enough to adequately view the lighted target. The tubes shall withstand the torque encountered in the steering process.
- d. Enlargement Casing - The enlargement casing shall be constructed of steel to a diameter just larger than the pipe sleeve and have a leading connection compatible with the pilot tube. The leading face of the casing shall possess several large openings for the soil to enter as it advances along the proposed alignment. An internal auger chamber shall funnel the excavated material into the temporary full diameter casings of the Three-Phase Process or into the internal auger casings of the Two-Phase Process. Structural members shall connect the leading edge of the casing to the pilot tube connections.
- e. Soil Transportation System - The soil transportation system shall consist of an auger train operating inside the full diameter temporary steel casings of the Three-Phase System and an internal casing and auger train operating inside the pipe sleeve. The internal casings of the Two-Phase Process shall be manufactured to minimize leakage of the excavated material into the pipe sleeve.
- f. Soil Removal - A soil removal system shall be provided to safely remove the excavated material from the drive shaft to the surface.
- g. Hydraulic Power Unit - The hydraulic power unit shall rest on the surface and be connected to the jacking frame by hoses. The unit shall meet all applicable noise standards.
- h. Lubrication System - A lubrication system shall be employed to minimize pipe friction to insure that pipe can be installed from the drive shaft to the receiver shaft within the safe working load rating of the pipe. The system may also be required to minimize the torque required to transport the excavated material to the drive shaft.
- i. Monitoring equipment shall be provided capable of continuously monitoring:
 - 1) The jacking pressure and advancement of the boring head.
 - 2) Deviation of the pilot tube microtunneling machine.
 - 3) Indication of the steering head.

2. Three Phase System

- a. Phase 1 - A rigid steel pilot tube in approximately one-meter lengths shall be installed through the ground from the drive shaft to the receiver shaft by earth displacement with

the microtunnel-jacking frame. The alignment of the pilot tube shall be established with a theodolite mounted at the rear of the drive shaft and accurately set to the desired line and grade. The theodolite shall view a lighted target in the lead or steering pilot tube. A camera shall be fitted to the theodolite and shall transmit the image of the crosshair and the target onto a monitor screen to be viewed in the drive shaft by the operator. As the operator advances the pilot tube through the earth the center of the target will drift from the crosshair as a result of the biased or slanted leading tip of the pilot tube. The operator shall rotate the pilot tube as require to orient the slanted steering tip toward the crosshair and continue to advance the pilot tube until it reaches the receiver shaft.

- b. Phase 2 - An enlargement casing with an outside diameter up to 1" larger than the pipe sleeve shall be rigidly connected to the final pilot tube and advanced into the earth behind the pilot tube. An auger shall be used inside the enlargement casing to remove the material being excavated. The auger shall be contained inside the limits of the enlargement casing as it progresses along the proposed alignment. A train of temporary steel casings with an outside diameter very similar to the enlargement casing and used to move the enlargement casing from the drive shaft to the receiver shaft. The enlargement casing will cut a borehole from the drive shaft to the receiver shaft and the temporary casings will case the hole as it is cut. Each temporary casing shall be fitted with an internal auger to transport the excavated material to the receiver shaft where it shall be removed from the shaft and disposed of at an approved location. The pilot tubes shall be recovered in the receiver shaft as the temporary casings are installed.
- c. Phase 3 - The pipe sleeve shall then be installed directly behind the temporary casing pipe with the jacking frame. The casing pipes and augers shall be recovered in the receiver shaft as the pipe sleeve is installed.

3. Two Phase System

- a. Phase 1 - The pilot tube shall be installed in the same manner described above.
 - b. Phase 2 - The enlargement casing shall be installed in the same manner described in Phase 2 of the Three-Phase System. Each pipe sleeve shall be fitted with an internal protective-casing pipe to house the auger and prevent damage to the pipe sleeve. The pipe sleeve shall be installed directly behind the enlargement casing with the internal casing rigidly connected to the auger chamber of the enlargement casing. The internal casing shall be manufactured such that the excavated material does not leak excessively into the pipe sleeve. The internal casing shall be fitted with a protective shoe to protect the pipe sleeve from damage and to support the casing and auger at the centerline of the pipe. The pipe sleeve shall be advanced along the proposed alignment with the jacking frame thus progressing the enlargement casing from the drive shaft to the receiver shaft with the pilot tubes being recovered in the receiver shaft. The excavated material shall be funneled into and conveyed through the internal casing to the drive shaft where it shall be removed from the shaft and disposed of at an approved location. Upon reaching the receiver shaft the enlargement casing shall be removed and the internal casings and augers refracted and recovered at the drive shaft.
- B. Drive and Receiving Shafts - Shafts diameter shall be minimized however shall be commensurate with safe working practices. Shafts shall be located at manhole locations and elsewhere as approved by the Engineer. The Contractor shall provide equipment as required to keep the shafts free of flowing or standing water while in use. The groundwater control system shall not result in a loss of fines for the soil surrounding the shaft. The Contractor shall assess during the design phase if the lowering of the groundwater in the vicinity of the shafts will have unacceptable impacts and if so shall preclude the lowering of the groundwater table. Groundwater may be

disposed of as directed by the Engineer. Design. and construction technique for drive and receiving shafts shall be the responsibility of the Contractor and, shall be in compliance with all applicable requirements. The Owner shall assume no responsibility for shaft design and or construction. Shaft design shall include all devices required for safe working conditions and shall be in compliance with OSHA and State requirements. The Contractor shall make provisions to prevent groundwater, if present, from flowing along the pipe into the shaft and prevent pipe lubricant from escaping into the shaft.

- C. Grade and Alignment Requirements – Pitch pipe towards pullboxes and away from distribution cabinets and control enclosures. Excessive steering should be avoided. Steering correction when required should not exceed 2” in 250”.
- D. Tunneling Overcut - The over cut of the enlargement casing shall be limited to no more than 1” of the diameter of the pipe sleeve to be installed.
- E. Ground Movement -
 - 1. The machine shall provide full support to the tunnel without the use of ground stabilization or other ground support techniques to allow the installation of the pipe.
 - 2. Drive and receiving shafts shall be designed in a manner to preclude settlement of the adjacent areas.
 - 3. Settlement of the ground surface along the centerline of the pipe during and after construction shall not exceed 0.5 inch.
 - 4. Repair of ground losses and or damage to structures due to ground losses that are a result of the pilot tube microtunneling operation shall be the responsibility of the Contractor.
 - 5. Repair of voids created during the pilot tube microtunneling operation shall be the responsibility of the Contractor. A plan of repair shall be prepared by the Contractor for review and approval by the Engineer.
 - 6. Voids greater than 0.5” beneath pavement shall be filled with a soil slurry mix approved by the Engineer.

1.5 Contractor Qualifications -

To qualify as a bidder on this project the Contractor shall as a minimum meet one of the following criteria:

- A. Successfully completed 3000 feet or 10 drives of pilot tube microtunneling using the type of equipment to be used or
- B. Meet both of the following criteria:
 - 1. Provide a representative of the manufacturer of the pilot tube microtunneling machine being used by the Contractor whose level of experience in pilot tube microtunneling is acceptable to the Engineer and
 - 2. Provide an operator with a minimum of 3000 feet or 10 drives of successful pilot tube microtunneling installation using the equipment to be used who will be in direct supervision of the pilot tube microtunneling operation at all times.

1.6 Submittals

- A. The Engineer will base the review of submitted details and data with consideration of requirements necessary for the completed work, including utility conflicts, and the possibility of unnecessary delays in the execution of the work to be constructed under this contract. The review of the submittals will not be to check the adequacy of design of the pilot tube microtunneling system, which is the responsibility of the Contractor, but to confirm that the items requested have been considered in developing the design. Review and acceptance of the Contractor submittals by the Engineer shall not be construed in any way as relieving the Contractor of his responsibilities under this contract. Such review by the Engineer shall not be construed by the Contractor as an endorsement by the Engineer that such methods are constructible or will work for the specific subsurface soils encountered.
- B. Submit for review a complete work plan including drawings showing details of the proposed method of construction. Include written descriptions as necessary to clearly indicate the manner in which the pipe installation will be performed including the sequence of work. Show the location of working shafts, including method of excavation, shoring and bracing, and dewatering techniques that are proposed to be used. The following is not intended to limit, but to provide the minimum of details, which must be included:
1. A quality control plan that includes at a minimum how supervision of installation shall be accomplished and procedures for assuring line and grade requirements are met. Include forms to be used to determine work progress.
 2. Manufacturer's literature describing in detail the microtunneling system to be used. Include the method of controlling line and grade of the Pilot Tube Microtunneling Machine and details of the pipe installation. Detailed description of projects on which this system has been successfully used, including the names, addresses and telephone numbers of owner's representative for these projects.
 3. Method of spoils removal including surface storage and disposal
 4. Method of controlling groundwater at the shafts by the microtunneling machine.
 5. Shaft dimensions, locations, surface construction, profile, and depth, method of excavation, and shoring and bracing.
 6. Shaft backfill material.
 7. Safety plan for shafts. Include details for security fences and shaft covers.
 8. Schedule of work.
 9. The manner in which the annular space will be filled.
 10. Pipe submittal should include Manufacturer's literature describing the microtunneling pipe, indicating allowable safe jacking loads with the designated safety factor. Anticipated jacking loads include the manner in which the anticipated jacking loads were generated. Provide details of pipe compression rings to safely distribute jacking forces and instructions on storage, handling, transporting and installation requirements. Design calculations prepared by the Contractor's Engineer and stamped by a Professional Engineer. Contractor may employ pipe Manufacturer for pipe design. Provide verification by the Manufacturer that the pipe complies with the design.
 11. Miscellaneous materials to be used on the job.
- C. Experience Record as required in Part 1.5 Contractor's Qualifications. Include name and experience record of superintendent, location of prior work performed including number of feet installed and pipe size, contact names and telephone numbers of Owner's representatives and name and experience record of PTMM operator.
- D. Such other information as the Engineer may request.

PART 2 - PRODUCTS

- A. Pipe – For each conduit run provide end-to-end continuous min. Sched. 40 HDPE conduit UL listed for the use. Conduit sleeves on this project shall be min. Sched 40 HDPE. Pipe selection is to be selected based on its use, and all loads that will be induced on the pipe. Pipe selected shall have a structural factor of safety of three (3).

Design of pipes shall include but not be limited to:

1. In-use loads for the project design life, which shall be defined as having a demonstrated life of 100 years. The in-use loads include but are not necessarily limited to internal operating, transient, and test pressures, soil overburden, surface loads, and external static water head. AASHTO H-20 shall be used for live load in roadway areas.
 2. Installation loads include but are not limited to jacking forces, external pressure from groundwater, soil loads and surface loads.
 3. Drive length, pipe length, pipe mechanical properties and quality control provided during manufacture of pipe.
 4. Provisions for protecting the driving end and intermediated points of the pipe.
- B. Lubricant shall be selected by the Contractor to achieve successful installation of the pipe system and shall not degrade the conduit material. Any additives used should meet NSF Standard 060.
- C. Minimum pipe sizes are shown on the plan set. Up sizing pipe sizes to accommodate the Contractor's operation will be considered by the Owner. No increase in pipe sizing is permitted without written approval of Owner. No additional compensation shall be paid to the Contractor for such increase of pipe size or any additional work that might be associated with this up sizing.

PART 3 - EXECUTION

- A. Methods of construction for the shafts, jacking pits, or other components of the construction shall be such as to ensure the safety of the work, Contractor's employees, the public and adjacent property, whether public or private. All damage to property shall be restored to equal or better condition than prior to construction.
- B. Selection of an excavation technique, excavation support system, and dewatering system is the contractor's responsibility. The Contractor is responsible to ensure all excavations are in compliance with all Federal State and Local regulations.
- C. All excavations shall be adequately ventilated. Air monitoring of the shafts or pits shall be conducted on a continuous basis.
- D. All work of excavation, shoring and bracing and tunneling shall be so executed that settlement is minimized.
- E. Before beginning construction at any location, the contractor must adequately protect existing structures, utilities, trees, shrubs and other permanent objects.
- F. The contractor shall place the drill with the least amount of disturbance to the existing pavement, berm pavement or shoulders of the roadway.

- G. The contractor shall exercise care not to damage the rigid conduit during installation. Damaged sections of conduit are not acceptable and shall have new conduit re-drilled. The conduit shall be a minimum 30 inches deep and extended at least 3 feet beyond the pavement and storm water channel's berms.
- H. The repair of or compensation for damage to permanent facilities due to negligence for lack of adequate protection on the part of the Contractor will be at no cost to the Owner.
- I. The Contractor shall provide surface drainage during the period of construction to protect the work and to avoid nuisance to adjoining property and to assure that surface runoff does not enter the entrance or exit shafts.
- J. The Contractor shall conduct his operations in such a fashion that trucks and other equipment does not create a dirt nuisance in the streets. The Contractor shall immediately remove and dispose of any spillage or excess dirt on the roadway.
- K. Blasting will not be permitted.
- L. The tunnel machine operator shall be fully trained on other tunneling projects on the use of the machinery on this project or at all times be under the direct supervision of a fully trained and designated operator.
- M. The machine shall be operated so as to prevent either surface heave or loss of ground during tunneling and shall be steerable to maintain line and grade within the tolerances specified.
- N. The thrust reaction backstop shall be properly designed and constructed. The backstop shall be normal to the proposed pipe alignment. The thrust wall shall be designed to support the maximum obtainable jacking pressure developed by the main jacking system and shall include a safety factor. Failure of the thrust block system and any corrective action required shall be the responsibility of the Contractor.
- O. The pipe shall be jacked in place without damaging the pipe joints or completed pipe section. Any pipe, which has been damaged during installation, shall be replaced by the Contractor at no additional cost to the Owner.
- P. All excavated material from the tunnel and shaft construction shall be disposed of away from the construction site. No stockpiling of material on the job-site will be permitted. Material shall be removed at regular intervals not exceeding 48 hours.
- Q. The Contractor shall monitor all ground movements associated with the work and maintain these within permissible tolerances. A baseline survey shall be prepared by the Owner prior to undertaking the tunneling work.

PART 4 - TESTING

- A. After the completion of each line segment, before the jacking frame has been removed, each completed drive section shall be low-pressure air tested in accordance with ASTM C 828, latest revision. Where the test fails the contractor shall abandon the old and provide a new line. All acceptance testing shall be completed prior to the removal of the jacking frame.

END OF SECTION 310523

SECTION 310913 - DEWATERING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes construction dewatering.

1.2 PERFORMANCE REQUIREMENTS

- A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control ground-water flow into excavations and permit construction to proceed on dry, stable subgrades.

1.3 SUBMITTALS

- A. Shop Drawings for Information: For dewatering system. Show arrangement, locations, and details of wells and well points; locations of headers and discharge lines; and means of discharge and disposal of water.
 - 1. Include Shop Drawings signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with water disposal requirements of authorities having jurisdiction.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.
 - 1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site and surrounding area.
 - 2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

3.2 INSTALLATION

- A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.
- B. Before excavating below ground-water level, place system into operation to lower water to specified levels. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed, or until dewatering is no longer required.
- C. Provide an adequate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.
 - 1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
- B. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
 - 1. Maintain piezometric water level a minimum of 24 inches (600 mm) 60 inches (1500 mm) below surface of excavation.
- C. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water in a manner that avoids inconvenience to others. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.
- D. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, restore damaged structures and foundation soils at no additional expense to Owner.
 - 1. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches (900 mm) below overlying construction.
- E. Damages: Promptly repair damages to adjacent facilities caused by dewatering operations.

END OF SECTION 310913

SECTION 311000 - SITE CLEARING

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. Removing existing vegetation.
 - 2. Clearing and grubbing.
 - 3. Stripping and stockpiling topsoil.
 - 4. Removing above- and below-grade site improvements.
 - 5. Disconnecting, capping or sealing, removing site utilities, and abandoning site utilities in place.
 - 6. Temporary erosion- and sedimentation-control measures.
- B. Related Sections:
 - 1. Division 01 Section "Execution"
 - 2. Division 01 Section "Construction Waste Management and Disposal"
 - 3. Division 31 Section "Erosion and Sedimentation Control"

1.3 DEFINITIONS

- A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.
- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other non-soil materials.
- D. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.
- E. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and indicated on Drawings defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line unless otherwise indicated on plans.
- F. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 MATERIAL OWNERSHIP

- A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 SUBMITTALS

- A. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 QUALITY ASSURANCE

- A. Pre-installation Conference: Conduct conference at the Project site.

1.7 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Utility Locator Service: Notify "North Carolina OneCall (811)" for area where Project is located before site clearing.
- C. Obtain UNCW "Dig Permit", keep permit current throughout construction, and keep University personnel current with planned construction activities and locations.
- D. Do not commence site clearing operations until temporary erosion- and sedimentation-control measures are in place and erosion control permit is obtained and posted at job-site.
- E. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Division 31 Section "Earth Moving."
 - 1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on- site.

PART 3 EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Locate and clearly identify trees, shrubs, and other vegetation to remain or to be relocated. Wrap a 1-inch blue vinyl tie tape flag around each tree trunk at 54 inches above the ground.
- C. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of NCDEQ.
- B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 EXISTING UTILITIES

- A. Owner will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.
 - 1. Verify that utilities have been disconnected and capped before proceeding with site clearing.
- B. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.
 - 1. Coordinate with Owner prior to shutting off any utilities.
 - 2. Arrange with utility companies to shut off indicated utilities.
- C. Locate, identify, and disconnect utilities indicated to be abandoned in place.
- D. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Owner, and Engineer not less than 7 days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Engineer's written permission.
- E. Excavate for and remove underground utilities indicated to be removed.
- F. Verify horizontal and vertical location of existing underground utilities to remain in service on construction site. Notify Owner and Engineer immediately if a conflict with construction activities is discovered.

3.4 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
 2. Grind down stumps and remove roots, obstructions, and debris to a depth of 18 inches below exposed subgrade.
 3. Chip removed tree branches and dispose of off-site.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.5 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along the line of existing pavement and concrete to remain before removing adjacent existing pavement or concrete. Saw-cut faces vertically.

3.6 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
- B. Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 311000

SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section.
- B. North Carolina Department of Transportation and City of Wilmington Standard Specifications and Details where applicable.

1.2 SUMMARY

- A. Section Includes:
 - 1. Preparing subgrades for slabs-on-grade, walks, pavements, turf and grasses, and plants.
 - 2. Excavating and backfilling for structures.
 - 3. Subbase course for concrete walks and pavements.
 - 4. Subbase course and base course for asphalt paving.
 - 5. Subsurface drainage backfill for walls and trenches.
 - 6. Excavating and backfilling trenches for utilities and pits for buried utility structures.
- B. Related Sections:
 - 1. Division 01 Section "Construction Progress Documentation" for recording pre-excavation and earth moving progress.
 - 2. Division 01 Section "Temporary Facilities and Controls" for temporary controls, utilities, and support facilities; also for temporary site fencing if not in another Section.
 - 3. Division 31 Section "Site Clearing" for site stripping, grubbing, stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
 - 4. Division 31 Section "Erosion and Sedimentation Control".
 - 5. Division 32 Section "Segmental Retaining Walls".
 - 6. Division 33 Section "Storm Utility Drainage Piping".

1.3 UNIT PRICES

- A. Work of this Section is affected by unit prices and quantity allowances for earth moving specified in Division 01 Section "Unit Prices and Allowances."

1.4 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- F. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.
- G. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
- H. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- I. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- J. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Engineer or Owner's Testing Agency. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
 2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
 3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer or Owner's Testing Agency. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.
- K. Fill: Soil materials used to raise existing grades.
- L. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- M. Reinforced Soil Fill: Soil materials specifically designed and compacted for use with Segmental Retaining walls designed by others.
- N. Structural Fill: Soil free of trash, refuse, frozen material, or other deleterious materials, and contains less than 3% organics. Shall be free of rock or gravel larger than allowed for fill or backfill material as specified hereinafter or as shown on the drawings.
- O. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
- P. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.5 SUBMITTALS

- A. Product Data: For each type of the following manufactured products required:
 1. Geosynthetics.
 2. Lime and/or cement utilized for soil/base modification.
 3. ABC stone

4. Detector warning tapes.
- B. Material Test Reports: For each off-site soil material proposed for fill and backfill as follows:
 1. Classification according to ASTM D 2487.
 2. Laboratory compaction curve according to ASTM D 698.
- C. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins.

1.6 QUALITY ASSURANCE

- A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.
- B. Pre-excavation Conference: Conduct conference at the Project Site prior to commencement of site grading.

1.7 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.
 1. Do not close or obstruct streets, parking lots, access drives, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Utility Locator Service: Obtain a Dig Permit from UNCW and notify "North Carolina OneCall (811)" for area where Project is located before beginning earth moving operations.
- C. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures, specified in Division 31 Sections "Site Clearing" and "Erosion and Sedimentation Control" are in place.
- D. Do not commence earth moving operations until a NCDEQ Erosion Control Plan Letter of Approval are obtained and posted at the project site.
- E. Do not commence earth moving operations until plant-protection measures specified in Division 01 Section "Temporary Tree and Plant Protection" are in place.
- F. The following practices are prohibited within protection zones:
 1. Storage of construction materials, debris, or excavated material.
 2. Parking vehicles or equipment.
 3. Foot traffic.
 4. Erection of sheds or structures.
 5. Impoundment of water.
 6. Excavation or other digging unless otherwise indicated.

- 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- G. Do not direct vehicle or equipment exhaust towards protection zones.
- H. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: Unified Soil Classification System (USCS) Groups SM, SC, SW, and SP according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, greater than 3% organic material, and other deleterious matter.
 - 1. Compacted to not less than 95% of the Standard Proctor maximum below 12" and not less than 98% of the standard Proctor maximum for the last 12".
 - 2. Fill soils should possess a standard Proctor maximum dry density of at least 100 pounds per cubic foot (pcf) for the structural fill and at least 90 pounds per cubic foot (pcf) for the low permeability fill.
- C. Unsatisfactory (or Unsuitable) Soils: Soil Classification Groups OL and OH according to ASTM D 2487, or a combination of these groups.
 - 1. Fill materials shall not be classified as unsatisfactory if the fill materials' natural moistures are outside the required moisture range and otherwise meet the material requirements for satisfactory materials. The contractor shall dry these materials to the acceptable moisture range.
- D. Base Course: Aggregate meeting the ABC stone requirements specified in section 1005-3 and 1005-4 of the North Carolina Department of Transportation Standard Specifications for Roads and Structures, January 2012.
- E. Structural Fill: Same as Satisfactory Soils.
- F. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.
- G. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No. 4 sieve.
- H. Sand: ASTM C 33; fine aggregate.
- I. Low Permeability Fill: ASTM D 2487; CL, CH, and MH soil classification groups or a combination of these groups; free of debris, waste, frozen materials, vegetation, and other deleterious matter. Shall have a maximum dimension of 3 inches. Shall have a permeability of equal to or less than that value indicated on the design drawings when compacted to the degree indicated on the design drawings.

- J. Dam Embankment/Key Trench: Unified Soil Classification System (USCS) Groups ML and CL according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 6 inches in any dimension, roots, stumps, wood, debris, waste, frozen materials, and other deleterious matter.
 - 1. All fill soils used in the Dam Embankment/Key Trench construction shall be compacted to at least 95% of the standard proctor maximum dry density (ASTM-698).
 - 2. Fill Soils shall be compacted at a moisture content within -1 to +3 percent of its optimum moisture content

2.2 GEOTEXTILES

- A. Subsurface Drainage / Separation Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; complying with AASHTO M 288 and the following, measured per test methods referenced:
 - 1. Grab Tensile Strength: 205 lb; ASTM D 4632.
 - 2. Grab Tensile Elongation: 50%; ASTM D 4632.
 - 3. Trapezoidal Tear Strength: 80 lb; ASTM D 4533.
 - 4. CBR Puncture Strength: 500 lb; ASTM D 6241.
 - 5. Apparent Opening Size: No. 80 sieve, maximum; ASTM D 4751.
 - 6. Permittivity: 1.1 per second, minimum; ASTM D 4491.
 - 7. UV Stability: 70 percent after 500 hours' exposure; ASTM D 4355.
- B. Stabilization Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
 - 1. Grab Tensile Strength: 247 lbf; ASTM D 4632.
 - 2. Sewn Seam Strength: 222 lbf; ASTM D 4632.
 - 3. Tear Strength: 90 lbf; ASTM D 4533.
 - 4. Puncture Strength: 90 lbf; ASTM D 4833.
 - 5. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
 - 6. Permittivity: 0.02 per second, minimum; ASTM D 4491.
 - 7. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.3 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored as follows:
 - 1. Red: Electric.
 - 2. Yellow: Gas, oil, steam, and dangerous materials.
 - 3. Orange: Telephone and other communications.
 - 4. Blue: Water systems.

5. Green: Sewer systems.
- B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:
 1. Red: Electric.
 2. Yellow: Gas, oil, steam, and dangerous materials.
 3. Orange: Telephone and other communications.
 4. Blue: Water systems.
 5. Green: Sewer systems.
- C. Detectable Tracer Wire: In accordance with NC General Statute 87-121 (g), the University requires a #12 solid bare copper wire is to be installed with gravity sewer mains and services, storm drainage systems, reuse mains and services, and any nonmetallic water service tubing. It is not required for DIP water mains or copper water services.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Follow Construction Sequence provided on Drawings.
- B. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.
- C. Protect and maintain erosion and sedimentation controls during earth moving operations.
- D. Remove from site, material encountered in grading operations that is unsatisfactory material or undesirable for backfilling, subgrade, or foundation purposes. Dispose of in manner satisfactory to Owner and local governing agencies. Backfill areas with layers of satisfactory material and compact as specified herein.
- E. Remove from site, material encountered in grading operations that is unsatisfactory material or undesirable for backfilling, subgrade, or foundation purposes. Dispose of in manner satisfactory to Owner and local governing agencies. Backfill areas with layers of satisfactory material and compact as specified herein.
- F. Prior to placing fill in low areas, such as previously existing creeks, or ponds, perform following procedures:
 1. Drain water out by gravity with ditch having flow line lower than lowest elevation in low area. If drainage cannot be performed by gravity ditch, use adequate pump to obtain the same results.
 2. After drainage of low area is complete, remove muck, mud, debris, and other unsatisfactory material by using acceptable equipment and methods that will keep natural soils underlying low area dry and undisturbed.

3. All muck, mud, and other materials removed from low areas shall be dried on-site by spreading in thin layers for observation. Material shall be inspected and, if found to be satisfactory for use as fill material, shall be incorporated into lowest elevation of site filling operation, but not within 5'-0" of perimeter of paving or retaining wall subgrade. If, after observation, material is found to be unsatisfactory, it shall be removed from site.
- G. After topsoil stripping, notify Owner's Testing Agency. Proof-roll exposed subgrades to identify soft pockets and areas of excess yielding. Do not proof-roll wet or frozen subgrades.
 1. Completely proof-roll subgrade in one direction with a heavy vibratory smooth drum roller, having a weight of at least 10 tons, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Engineer or Owner's Testing Agency, and replace with compacted backfill or fill as directed.
- H. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 EXPLOSIVES

- A. Explosives and/or blasting are expressly prohibited.

3.3 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include pavements, underground structures, utilities, obstructions, and other items indicated to be removed; together with soil, boulders, and rock. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation, removal of obstructions, or unsuitable soils to subgrade elevation.
 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials, replace with satisfactory materials.
- B. Unsatisfactory Soils: Volume of unsatisfactory soils and/or unsuitable debris actually removed below the subgrade/bearing elevation, measured in original position, and replaced with satisfactory subgrade/foundation material that meets the allowable design bearing pressure, compaction requirements, and construction documents for the site and structure. Unsatisfactory soils shall not be removed until approved and the volume is determined by measuring the excavation by the Owner's Testing Agency. Truck counts will not be accepted as a method to determine unsatisfactory soils removed. Changes in the Contract Sum or the Contract Time will be in accordance with Allowances and Unit Prices provisions for removal and replacement of unsuitable soils.

3.4 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and

removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
 2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch (25 mm). Do not disturb bottom of excavations intended as bearing surfaces.
- B. Excavations at Edges of Tree- and Plant-Protection Zones:
1. Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
 2. Cut and protect roots according to requirements in Division 01 Section "Temporary Tree and Plant Protection."

3.5 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.6 SUBGRADE EVALUATION

- A. Notify Owner's Testing Agency when excavations have reached required subgrade.
- B. If Owner's Testing Agency determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-roll subgrade below pavements in to identify soft pockets and areas of excess yielding. Do not proofroll wet or frozen subgrades.
1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Engineer or Owner's Testing Agency, and replace with compacted backfill or fill as directed.
- D. No changes in the Contract Sum or the Contract Time will be authorized for removal of obstructions, or unsuitable soils to subgrade elevation.
- E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer, without additional compensation.

3.7 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavations as directed by Engineer.

3.8 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Stockpile soil materials away from edge of excavations.
 - 2. Place silt fence approximately 3-ft from edge of stockpile.
 - 3. Do not store within drip line of remaining trees.

3.9 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
 - 2. Surveying locations of underground utilities for Record Documents.
 - 3. Testing and inspecting underground utilities.
 - 4. Removing concrete formwork.
 - 5. Removing trash and debris.
 - 6. Removing temporary shoring and bracing, and sheeting.
 - 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.10 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil.
- D. Trenches under Roadways: After installing and testing piping or conduit less than 30 inches below surface of roadways, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase course. Concrete is specified in Division 03 Section "Cast-in-Place Concrete."
- E. Backfill voids with satisfactory soil compacted in accordance with specifications provided herein while removing shoring and bracing.
- F. Place and compact initial backfill of subbase material and satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.
 - 1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

- G. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- H. All underground piping and utilities (both metallic and non-metallic), except lawn irrigation lines, shall have two stages of identification and/or warning by a combination of non-detectable and detectable warning tapes.
- I. Install warning tape (detectable warning tape) directly on top of the pipeline and permanently secured to the pipeline at 10' intervals.
- J. Install identification tape (non-detectable warning tape) approximately 18" to 30" above the service pipe, but a minimum of 10" and a maximum of 24" below finished grade.
- K. Install tracer wire to bottom of pipe taped at a maximum of 10' intervals. An insulated copper tracer wire or other approved conductor shall be installed along the length of the pipe to all nonmetallic piping, including irrigation lines, and metallic pipe with compression gasket fittings installed underground. Access shall be provided to the tracer wire or the tracer wire shall terminate aboveground at the end of the nonmetallic piping. The tracer wire size shall be copper single-conductor 10AWG minimum and the insulation type suitable for direct burial with type "UF" (Underground Feeder) insulation and shall be continuous along the pipeline passing through the inside of each valve box or manhole.

3.11 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers using satisfactory fill (or structural fill) to required elevations.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.12 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 3 percent of optimum moisture content.
 - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Fill materials shall not be classified as unsatisfactory if the fill materials' natural moistures are outside the required moisture range and otherwise meet the material requirements for satisfactory materials. The contractor shall dry these materials to the acceptable moisture range.
 - 3. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 3 percent and is too wet to compact to specified dry unit weight.

3.13 COMPACTION OF SOIL BACKFILLS AND FILLS

- B. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

- C. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- D. Compact as follows:

Location	Percent of Maximum Laboratory Density ASTM D698
Subgrade and Fill below Structures and Pavement (top 12 inches)	98
Subgrade and Fill below Structures and Pavement (below top 12 inches)	95
Subgrade & Fill in All other Areas	90

3.14 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 - 1. Turf or Unpaved Areas: Plus or minus 1 inch.
 - 2. Walks: Plus or minus 1 inch.
 - 3. Pavements: Plus or minus 1/2 inch.

3.15 BASE COURSES UNDER PAVEMENTS AND WALKS

- A. Place base course on subgrades approved by the Owner's Testing Agency free of mud, frost, snow, or ice.
- B. On prepared subgrade, place base course under pavements and walks as follows:
 - 1. Place base course material over subgrade under hot-mix asphalt pavement.
 - 2. Shape base course to required crown elevations and cross-slope grades.
 - 3. Place base course 10 inches or less in compacted thickness in a single layer.
 - 4. Place base course that exceeds 10 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 4 inches thick.
 - 5. Compact base course at moisture content within +/- 2% of optimum moisture to required grades, lines, cross sections, and thickness to not less than 98 percent of maximum dry unit weight according to AASHTO T-180 as modified by NCDOT.
- C. Pavement Shoulders: Place shoulders along edges of base course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials and compact simultaneously with each base layer to not less than 98 percent of maximum dry unit weight according to AASHTO T-180 as modified by NCDOT.

3.16 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
 - 2. Determine that fill material and maximum lift thickness comply with requirements.
 - 3. Determine, at the required frequency, that in-place density of compacted fill complies with requirements.
 - 4. Full-time observation and testing for retaining walls.
- B. Owner's Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.
- C. Allow testing agency to evaluate and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Engineer.
- E. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
 - 1. Paved: At subgrade and at each compacted fill and backfill layer, at least one test for every 2500 sq. ft. or less of paved area, but in no case fewer than three tests.
 - 2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet or less of wall length, but no fewer than two tests.
 - 3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length, but no fewer than two tests.
- F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.17 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as directed by Engineer; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.
- D. Maintain subgrades to receive base course stone within compaction and moisture requirements continuously until stone is placed.

3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Transport surplus satisfactory soil and topsoil to designated storage areas on Owner's property or remove from site and legally dispose as directed by Engineer. Stockpile or spread soil as directed by Engineer.
 1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000

SECTION 312317 – TRENCHING

PART 1 GENERAL

1.1 GENERAL NOTES

- A. Prior to beginning Work, Contractor to request a field inspection with the Owner and Engineer for inspection before project start and before project acceptance.
- B. Trenches for underground piping, where necessary shall be excavated to the required depth and bell holes shall be provided where necessary to insure uniform bearing. Trench excavation lines shall provide sufficient clearance for proper execution of underground work.
- C. Trenches shall be open cut from the surface. Irregularities at bottom of trench, or where excavation is below required depth shall be refilled to required grade with compacted soil, or flowable fill at direction of onsite geotechnical engineer.
- D. The Contractor shall be held responsible for the sufficiency of sheeting and bracing and for all damages to property or injury to persons resulting from improper quality, strength, placing and maintenance of trench shoring, sheeting or bracing.
- E. Existing utility lines to be retained that are shown on construction drawings or locations of which are made known to the Contractor prior to excavation operations, shall be protected from damage during excavation and backfilling, and if damaged shall be repaired by Contractor, at own expense.
- F. Existing utility lines found during excavations that were not shown on construction drawings or made known to Contractor prior to excavation shall be protected and remain uninterrupted until approval by Owner or Engineer to proceed.
- G. The Contractor shall be responsible for providing and maintaining a pedestrian and traffic control plan in accordance with University standards.
- H. All underground utilities encountered during the projects construction shall be located by a Professional Land Surveyor licensed in North Carolina.

1.2 DEFINITIONS

- A. Standard Specifications: When referenced in this section, shall mean North Carolina Department of Transportation Road and Bridge Specifications, January 2012. Parts of these Standard Specifications that are specifically referenced shall become part of this section as though stated herein in full. In case of a discrepancy between the requirements of the Standard Specifications and the requirements stated herein, the requirements herein shall prevail.

1.3 SUMMARY

- A. Section Includes:
 - 1. Excavating trenches for utilities from 5 feet outside any building to terminating connection.

2. Compacted fill from top of utility bedding to finished grade.
3. Backfilling and compaction.
- B. Related sections:
 1. Section 312000 – “Earth Moving”
 2. Section 312919 – “Dewatering”
 3. Section 312500 – “Erosion and Sedimentation Control”

1.4 SUBMITTALS

- A. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan.
- B. Product Data: Geotextile fabric indicating fabric and construction.
- C. Materials Source: Name of imported fill materials suppliers.

1.5 QUALITY ASSURANCE

- A. Perform Work according to NCDOT and City of Wilmington standards.
- B. Prepare excavation protection plan under direct supervision of professional engineer experienced in design of this Work and licensed in State of North Carolina.

1.6 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.7 COORDINATION

- A. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

PART 2 PRODUCTS

2.1 FILL MATERIALS

- A. Subsoil Fill: Type as specified in Standard Specifications.
- B. Structural Fill: Type as specified in Standard Specifications.
- C. Granular Fill: Type as specified in Standard Specifications.
- D. Concrete:
 1. Lean concrete.

2.2 ACCESSORIES

- A. Geotextile Fabric: Non-biodegradable, non-woven. Use NCDOT standard for fabric application and type by use.

PART 3 EXECUTION

3.1 LINES AND GRADES

- A. Lay pipes to lines and grades indicated.
 - 1. Engineer may make changes in lines, grades, and depths of utilities when changes are required for Project conditions.
- B. Use laser-beam instrument with qualified operator to establish lines and grades.

3.2 PREPARATION

- A. Call local utility line information service at 811 not less than three working days before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Obtain UNCW "Dig Permit".
- C. Identify required lines, levels, contours, and datum locations.
- D. Protect plant life, lawns, and other features remaining as portion of final landscaping.
- E. Protect bench marks, existing structures, trees, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- F. Maintain and protect above and below grade utilities indicated to remain.
- G. Establish temporary traffic control and detours when trenching is performed in public right-of-way. Relocate controls and reroute traffic as required during progress of Work.

3.3 TRENCHING

- A. Excavate subsoil required for utilities.
- B. Remove lumped subsoil, boulders, and rock over 6 inches.
- C. Perform excavation within 24 inches of existing utility service according to utility's requirements.
- D. Do not advance open trench more than 200 feet ahead of installed pipe.
- E. Cut trenches sufficiently wide to enable installation and allow inspection. Remove water or materials that interfere with Work, dewater in accordance with Section 31 23 19.
- F. Excavate bottom of trenches to a maximum of 2 feet past outside diameter dimensions or outside of concrete cradle.
- G. Excavate trenches to depth indicated on Drawings. Provide uniform and continuous bearing and support for bedding material and pipe.

- H. When Project conditions permit, slope side walls of excavation starting 24 inches above top of pipe. When side walls cannot be sloped, provide sheeting and shoring to protect excavation as specified in this Section.
- I. When subsurface materials at bottom of trench are loose or soft, excavate to greater depth as directed by onsite Geotechnical Engineer until suitable material is encountered.
- J. Cut out soft areas of subgrade not capable of compaction in place. Backfill with flowable fill or geotechnical engineer approved fill and compact to density equal to or greater than requirements for subsequent backfill material.
- K. Trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.
- L. Correct areas over excavated areas with compacted backfill as specified for authorized excavation or replace with fill concrete as directed by Engineer.
- M. Remove excess subsoil not intended for reuse, from Site.
- N. Stockpile excavated material in area designated on Site according to Section 31 25 00.

3.4 SHEETING AND SHORING

- A. Sheet, shore, and brace excavations to prevent danger to persons, structures and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.
- B. Support trenches excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation or at direction of onsite geotechnical engineer.
- C. Design sheeting and shoring to be removed at completion of excavation Work.
- D. Repair damage caused by failure of sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.
- E. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

3.5 BACKFILLING

- A. Backfill trenches to contours and elevations with unfrozen fill materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- C. Place fill material in continuous layers and compact.
- D. Protect open trench to protect the public.

3.6 FIELD QUALITY CONTROL

- A. Perform laboratory material tests according to ASTM D1557.
- B. Perform in place compaction tests according to following:
 - 1. Density Tests: ASTM D1556.
 - 2. Moisture Tests: ASTM D3017.
- C. When tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest.

- D. Test as required in Section 31200, "Field Quality Control".

3.7 PROTECTION OF FINISHED WORK

- A. Reshape and re-compact fills subjected to vehicular traffic during construction.

END OF SECTION 312317

SECTION 312500 - EROSION AND SEDIMENTATION CONTROL

PART 1 GENERAL

1.1 SUMMARY

- A. This section covers work necessary for stabilization of soil to prevent erosion during and after construction and land disturbance activities. The work shall include furnishing all labor, materials, tools, and equipment to perform all work and services necessary for or incidental to the furnishing and installation, complete, of all operations in connection with erosion control as shown on drawings and as specified, in accordance with provisions of the Contract Documents, and completely coordinated with work of all other trades. The Contractor shall insure that all sedimentation features are in place prior to construction as necessary. Contractor shall remove the features as ground cover is established with approval of the Engineer and/or controlling authorities.
- B. The minimum areas requiring soil erosion and sediment control measures are indicated on the Drawings. The right is reserved to modify the use, location, and quantities of soil erosion and sedimentation control measures based on activities of the Contractor and as the Engineer considers to be the best interest of the Owner.
- C. Any governmental agency standard as noted below should be referenced as the latest, most recent, or current version of the referenced standard.
- D. The Contractor shall implement the approved Erosion and Sediment Control plan and follow all state requirements regarding sedimentation and erosion control. Construction methods shall minimize sedimentation and erosion.
- E. See additional information noted on the Drawings.

1.2 DEFINITIONS

- A. NCDOT: North Carolina Department of Transportation
- B. NCDEQ - DEMLR: North Carolina Department of Environmental Quality - Division of Energy, Mineral, and Land Resources.

1.3 GENERAL

- A. See Division 01, "General Requirements," which contain information and requirements that apply to the Work specified herein and are mandatory for this project.
- B. All activities shall conform to the Standard Erosion Control Specification: North Carolina Erosion and Sediment Control Planning and Design Manual, latest version; the NCDEQ

erosion control permit; the Specifications; and the Drawings. In the event of a conflict, the more stringent requirement shall apply.

- C. The Sections of the Standard Erosion Control Specifications referenced include, but are not limited to:

Standard & Specification No	Title
6.06	Temporary Gravel Construction Entrance / Exit
6.10	Temporary Seeding
6.17	Rolled Erosion Control Products
6.21	Temporary Diversions
6.32	Temporary Slope Drains
6.51	Hardware Cloth and Gravel Inlet Protection
6.64	Skimmer Basin
6.62	Sediment Fence (Silt Fence)
6.80	Construction Road Stabilization
6.83	Check Dam

- D. Soil erosion stabilization and sedimentation control shall consist of the following elements:
1. Maintenance of existing permanent or temporary storm drainage piping and channel systems, as necessary.
 2. Construction of new permanent or temporary storm drainage piping and channel systems, as necessary.
 3. Construction of temporary erosion control facilities such as silt fences, inlet protection, etc.
 4. Topsoil, Temporary Seeding, and Sod:
 - a. Placement and maintenance of Temporary Seeding on all areas disturbed by construction, as necessary.
 - b. Placement of permanent topsoil, fertilizer, and sod, etc. in areas as specified on the Drawings.
 5. It is the intent that all areas in which construction activities have disturbed existing vegetation shall be temporarily seeded, as required, topsoiled, and permanently sodded.

- E. The Contractor shall be responsible for phasing Work in areas allocated for his / her exclusive use during this Project, including any proposed stockpile areas, to restrict sediment transport. This will include installation of any temporary erosion control devices, ditches, or other facilities that may be required to comply with NCDEQ-DEMLR regulations and requirements.
- F. The areas set aside for the Contractor's use during the Project may be temporarily developed to provide satisfactory working, staging, and administrative areas for his / her exclusive use. Preparation of these areas shall be in accordance with other requirements contained within these Specifications and shall be done in a manner to both control all sediment transport from the project area, and to permit the area to be returned to design grades and drainage patterns upon completion of the project.
- G. Upon completion of the Project, all areas that have been disturbed by the Contractor shall be stabilized by top-soiling and permanent sodding.
- H. All permanent stockpiles, if any, shall be seeded with soil stabilization seed and protected by construction of two (2) rows of silt fence.
- I. Sediment transport and erosion from working stockpiles shall be controlled and restricted from moving beyond the immediate stockpile area by construction of temporary silt fence, as necessary. The Contractor shall keep these temporary facilities in operational condition by regular cleaning, re-grading, and maintenance.
- J. The Contractor shall maintain all elements of the Soil Erosion Stabilization and Sedimentation Control systems to be constructed during this Project for the duration of his / her activities on this Project. Formal inspections made jointly by the Contractor and the Engineer shall be conducted every 2 weeks to evaluate the Contractor's conformance to the requirements of both these Specifications and NCDEQ regulations.
- K. Maintenance of the Soil Erosion Stabilization and Sedimentation Control systems constructed as part of this project shall be in accordance with the Drawings and NCDEQ Standard Erosion Control Specifications.

1.4 SUBMITTALS

- A. Submittals shall be made in accordance with the Specifications, Section 013300, "Submittal Procedures."
- B. In addition, the Contractor shall provide the following specific information:
 - 1. If Contractor plans to vary erosion control phasing from the Drawings, then he / she shall submit a written plan, including definition and locations of phased erosion and sediment control for areas that will be disturbed during staged construction sequences. This information shall be provided to the Engineer and Owner, for review, before commencing any Work on the Project.

1.5 QUALITY ASSURANCE

- A. Perform Work according to NCDEQ and NCDOT standards.

1.6 INSPECTIONS AND RECORD KEEPING

- A. The Contractor is responsible for self-inspection of sedimentation and erosion control devices throughout the life of the Work, including preparation of self-inspection reports and NPDES Self-Monitoring Reports, to make sure the approved erosion and sedimentation control plan is being followed. To simplify documentation of Self-Inspection Reports and NPDES Self-Monitoring Reports, Contractor shall use a combined form available at <http://portal.ncdenr.org/web/lr/erosion>.
- B. Contractor shall refer to Self-Inspection Reports Reporting Requirements on Drawings.
- C. Contractor shall maintain a record keeping box, on-site with a rain gauge, whereby storm water records are kept and are easily accessible for site inspectors.

PART 2 PRODUCTS

2.1 AGGREGATE

- A. Temporary Construction Entrance
 - 1. Contractor shall use 2" – 3" washed stone.
- B. Silt Fence Outlet
 - 1. Contractor shall use #57 washed stone furnished according to NCDOT Standard Specifications for Roads and Structures, latest.

2.2 GEOTEXTILES

- A. SEDIMENT FENCE GEOTEXTILE
 - 1. Contractor shall use a synthetic filter fabric of at least 95% by weight of polyolefins or polyester, which is certified by the manufacturer or supplier as conforming to the requirements in ASTM D 6461, which is shown in the table below.
 - 2. Synthetic filter fabric should contain ultraviolet ray inhibitors and stabilizers to provide a minimum of 6 months of expected usable construction life at a temperature range of 0 to 120°F.

Temporary Silt Fence Material Property Requirements

	Test Material	Units	Supported ¹ of silt fence	Un-Supported ¹ Silt Fence	Type Value
Grab Strength	ATSM D4632	N (lbs)			
Machine			400	550	
Direction			MARV		
			(90)	(90)	
x-Machine			400	450	
Direction			MARV		
			(90)	(90)	
Permittivity ²	ASTM D 4491	sec-1	0.05	0.05	
	MARV				
Apparent		mm	0.60	0.60	Max.
Opening Size ²					
ARV ³		(US Seive#)	(30)	30)	
		%	70% after	70% after	

¹ Silt Fence support shall consist of 14 gage steel wire with a mesh spacing of 150 mm (6 inches), or prefabricated polymer mesh of equivalent strength.

² These default values are based on empirical evidence with a variety of sediment. For environmentally sensitive areas, a review of previous experience and/or site or regionally specific geotextile tests in accordance with Test Method D 5141 should be performed by the agency to confirm suitability of these requirements.

³ As measured in accordance with Test Method D 4632.

B. CONSTRUCTION ENTRANCE GEOTEXTILE

- Contractor shall use a synthetic geotextile meeting the requirements of a Type 2 engineering fabric shown in Table 1056-1 of the NCDOT Standard Specifications for Roads and Structures, latest.

C. ROLLED EROSION CONTROL BLANKET

- Rolled erosion control blankets shall have a minimum allowable shear stress of 1.5-lbs/ft² and a minimum longevity of 12 months
- Anchoring devices for rolled erosion control blankets shall be minimum 11 gauge staples, 1-in wide, and 6-in long or 12-in minimum length wooden stakes.

2.3 TEMPORARY SLOPE DRAINS

- Temporary slope drains shall be corrugated HDPE pipe.

2.4 SKIMMER BASIN

- A. Skimmer shall meet the design requirements of the drawings and the Standard Erosion Control Specifications
- B. Porous baffles shall be reinforced coir fiber with a minimum of 700-g/m².

2.5 SEDIMENT FENCE STEEL POSTS

- A. Contractor shall use posts for sediment fences are 1.25 lb./linear ft. minimum steel with a minimum length of 5 feet. Contractor shall make sure that steel posts have projections to facilitate fastening the fabric.

2.6 SEDIMENT FENCE FABRIC REINFORCEMENT

- A. For reinforcement of standard strength filter fabric, Contractor shall use wire fence with a minimum 14 gauge and a maximum mesh spacing of 6 inches.

2.7 PLANTING MATERIALS

- A. Temporary Seeding and Soil Supplements:
 - 1. Furnish according to Standard Erosion Control Specification
- B. Permanent Seeding (if used)
 - 1. Furnish according to Standard Erosion Control Specification
- C. Sod (if used)
 - 1. Furnish according to Standard Erosion Control Specification

PART 3 EXECUTION

3.1 GENERAL

- A. The Contractor shall install erosion and sediment control measures and maintain in accordance with the Drawings, the sequence of construction shown on the Drawings are made a part of these Contract Documents.
- B. The Contractor shall install any additional measures which the Engineer or NCDEQ Inspector may deem necessary to comply with the Standard Erosion Control Specification General Criteria or NCDEQ Erosion Control requirements, at no additional cost to the Owner.
- C. The Contractor shall provide and maintain Temporary Seeding at all times.

3.2 SILT FENCE

- A. Silt fence to be installed as indicated on Drawings and per the Standard Erosion Control Specification. Silt fence to be placed prior to demolition, trench installations, or other clearing activities. Silt fence may be temporarily removed and replaced to facilitate construction.
- B. Maintenance shall be performed per the Standard Erosion Control Specification.
- C. After ground cover has been established and approved by Engineer and NCDENR Erosion Control Inspector, the silt fence shall be removed and disposed of in an approved off-site location at the Contractor's expense.

3.3 SILT FENCE OUTLETS

- A. Install silt fence outlets per the details shown on Drawings and per the Standard Erosion Control Specification.
- B. Maintenance shall be performed per the Standard Erosion Control Specification.
- C. Contractor to verify silt fence outlet placement at low points as they exist or develop. Additional silt fence outlets may be required to prevent erosion during and after construction and land disturbance activities. If additional silt fence outlets are necessary, Contractor to add additional silt fence outlets per Engineer, NCDEQ Erosion Control Inspector, or Owner direction.

3.4 TEMPORARY DIVERSION DITCHES AND SLOPE DRAINS

- A. Install temporary diversion ditches as shown on the drawings, details and per the Standard Erosion Control Specification.
- B. Where shown on the drawings, install rolled erosion control blankets and rock check dams per the details and the Standard Erosion Control Specification.
- C. Install temporary slope drains per the drawings and the Standard Erosion Control Specification where runoff from diversion ditches enters the sediment basins, as shown on the drawings.
- D. Maintenance shall be performed per the Standard Erosion Control Specification.

3.5 SKIMMER BASINS

- A. Install skimmer basins as shown on the drawings per the details and the Standard Erosion Control Specification.
- B. Permanent stormwater management devices that are temporarily used as skimmer basins shall be constructed per the drawings, details and specifications of the final stormwater management facility.

- C. Maintenance shall be performed per the Standard Erosion Control Specification.

3.6 INLET PROTECTION

- A. Install Inlet Protection per the detail shown on Drawings and per the Standard Erosion Control Specification.
- B. Inlet protection shall be placed at the upstream side of any pipe or structure discharging outside of the disturbed limits. See Drawings for location.

3.7 CONSTRUCTION ENTRANCE

- A. Install construction entrance per the detail shown on Drawings and per the Standard Erosion Control Specification.
- B. Shall be maintained in a condition to prevent tracking or direct flow of mud onto adjacent roadways.

3.8 STOCKPILES

- A. Install stockpiles per the detail shown on Drawings and per the Standard Erosion Control Specification.
- B. Stockpile height shall not to exceed 15 feet and side slopes shall be 2 (H) to 1 (V) or flatter.
- C. Stockpile shall have a minimum double row of silt fence as shown on Drawings.

3.9 GROUND STABILIZATION

- A. Contractor shall provide ground stabilization per the Standard Erosion Control Specification and in accordance with the table below

B.

Site Area Description	Stabilization Time Frame	Stabilization Time Frame Exceptions
Perimeter Dikes, Swales, Ditches, and Slope	7 Days	None
High Quality Water (HQW) Zones	7 Days	None
Slopes Steeper Than 3:1	7 Days	If Slopes are 10' or less in length and are not steeper than 2:1, 14 Days

Slopes 3:1 or Flatter	14 Days	7-Days for slopes greater than 50-ft in length
All other areas with slopes flatter than 4:1	14 Days	None (except for perimeters and HQW zones)

3.10 TEMPORARY SEEDING

- A. Temporary Seeding is to be placed and maintained over all disturbed areas prior to Permanent Sodding per the detail shown on Drawings and per the Standard Erosion Control Specification
- B. Maintain Temporary Seeding until such time as areas are approved for permanent seeding. As a minimum, maintenance shall include the following:
 - 1. Fix-up and reseeding of bare areas or re-disturbed areas.
 - 2. Mowing for stands of grass or weeds exceeding 6 inches in height.

END OF SECTION 312500

SECTION 321216 - ASPHALT PAVING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Hot-mix asphalt paving.
 - 2. Hot-mix asphalt paving overlay.
 - 3. Asphalt surface treatments.
 - 4. Pavement-marking paint.
- B. Related Sections:
 - 1. Section 312000 "Earth Moving" for aggregate subbase and base courses and for aggregate pavement shoulders.

1.3 DEFINITION

- A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 and Standard Specifications of North Carolina Department of Transportation (NCDOT) for definitions of terms.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
 - 1. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
- B. Shop Drawings: Indicate pavement markings and lane separations.
- C. Material Certificates: For each paving material, from manufacturer.
- D. Material Test Reports: For each paving material.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by NCDOT.
- B. Installer Qualifications: Imprinted-asphalt manufacturer's authorized installer who is trained and approved for installation of imprinted asphalt required for this Project.
- C. Testing Agency Qualifications: Qualified according to ASTM D 3666 and NCDOT for testing indicated.
- D. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the NCDOT Standard Specifications (latest version) and the City of Wilmington for asphalt paving work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.
- E. Pre-installation Conference: Conduct conference at Project Site.
 1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:
 - a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
 - b. Review condition of subgrade and preparatory work.
 - c. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
 - d. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
- F. Contractor shall provide and conduct a quality control program as defined as all activities, including mix design, process control inspection, sampling and testing, and necessary adjustments in the process that are related to the production of the pavement in accordance with NCDOT's "Hot Mix Asphalt Quality Management System" (HMA / QMS) manual which is in force on the date of the contract advertisement.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.
- B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if base is frozen, wet or excessively damp, if rain is imminent or expected before time required for adequate cure, in accordance with Table 610-3 from the NCDOT Standard Specifications.
- B. Pavement-Marking: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials 55 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 PRODUCTS

2.1 AGGREGATES

- A. Coarse Aggregate, Fine Aggregate, and Mineral Filler
 1. In accordance with the requirements of Section 520 NCDOT Standard Specifications and the Drawings.

2.2 ASPHALT MATERIALS

- A. All materials utilized in the production of hot mix asphalt shall meet NCDOT applicable requirements of the provisions from Section 610 titled "Asphalt Concrete Plant Mix Pavement," for the type of Superpave plant mix pavement specified on the Drawings.

2.3 MIXES

- A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by NCDOT; designed according to procedures in AI MS-2, "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types"; and complying with the following requirements:
 - 1. Types SF-9.5A and S-9.5B.

2.4 DESIGN SECTIONS

- A. All sections shall be in accordance with pavement recommendations.
- B. Light Duty: 2-inches of Surface S-9.5B over 8-inches of compacted ABC Stone subgrade.
- C. Heavy Duty: 3-inches of Surface S-9.5B over 8-inches of compacted ABC stone subgrade.
- D. Rigid: 6-inches of 4,000 psi concrete over 4 inches of compacted ABC stone.

2.5 AUXILIARY MATERIALS

- A. Pavement-Marking Paint: MPI #32 Alkyd Traffic Marking Paint.
 - 1. Color: As indicated.
- B. Pavement-Marking Paint: MPI #97 Latex Traffic Marking Paint.
 - 1. Color: As indicated.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify that base course is dry and in suitable condition to begin paving.
- B. Proof-roll subgrade below pavements with a heavy vibratory smooth drum roller, having a weight of at least 10 tons, making repeated passes over the subject area to identify soft pockets and areas that rut, pump or deflect excessively. Proof-rolling shall be observed and areas repaired as recommended by Owner's Testing Agency prior to paving. Do not proof-roll wet or saturated base course.
 - 1. Completely proof-roll base course in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
 - 2. Excavate soft spots, unsatisfactory stone and/or soils, and areas of excessive pumping or rutting, as determined by Owner's Testing Agency, and replace with compacted ABC stone or fill as directed.
- C. Proceed with paving only after unsatisfactory conditions have been corrected and verified by Owner's Testing Agency.

3.2 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared base course is ready to receive paving.
- B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared surface of compacted-aggregate base before applying paving materials.
- C. Tack Coat: Apply uniformly to surfaces of existing pavement and abutting concrete surfaces at a rate of 0.05 to 0.15 gal./sq. yd.
 - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.3 HOT-MIX ASPHALT PLACING

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off in accordance with NCDOT requirements. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted per Drawings.
- B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.
- D. Mix and environmental temperatures should be in accordance with NCDOT requirements and should be documented the Owner's Testing Agency by NCDOT certified technicians.

3.4 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
 - 1. Clean contact surfaces and apply tack coat to joints.
 - 2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
 - 3. Offset transverse joints, in successive courses, a minimum of 24 inches.
 - 4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."
 - 5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.

6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.5 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted as follows:
 1. Target Average Density (S-9.5B): 92 percent of theoretical maximum density according to AASHTO T166, T275, or T331, with no individual test less than 90 percent nor greater than 100 percent.
 2. Target Average Density (SF-9.5A): 90 percent of theoretical maximum density according to AASHTO T166, T275, or T331, with no individual test less than 88 percent nor greater than 98 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness. Cutting and patching of newly placed asphalt is unacceptable. If defective asphalt is discovered, milling of asphalt and replacement with new asphalt will be required.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.6 INSTALLATION TOLERANCES

- A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
 1. Initial Course: Plus or minus 1/2 inch or per NCDOT requirements, whichever is more stringent.
 2. Surface Course: Plus 1/4 inch, no minus or per NCDOT requirements, whichever is more stringent.

- B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
1. Initial Course: 1/4 inch.
 2. Surface Course: 1/8 inch.
 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.7 PAVEMENT MARKING

- A. Apply temporary traffic marking paint – Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II, with drying time of less than three minutes.
- B. Permanent Pavement Markings – Thermoplastic Composition shall be placed in accordance with NCDOT specifications.
1. Thermoplastic Alkyd/Maleic and Hydrocarbon pavement markings shall be composed of the following materials:

COMPONENT BY WEIGHT

Alkyd/Maleic Binder	18.0%	Min.
Hydrocarbon Binder	22.0%	Min.
Glass Beads (Premixed)	30.0%	Min.
Titanium Dioxide (ASTM D-476, Type 2).....	10.0%	Min.
Yellow Pigment (For Yellow Marking Only)	4.0%	Min.

2. Calcium carbonate and inert fillers shall be opted by the manufacturer, providing all other specifications are met.
3. The total silica content used in the formulation of the thermoplastic shall be the premixed glass beads.
4. The pigment, beads, and filler shall be uniformly dispersed in the binder.
5. The Alkyd/Maleic binder shall consist of a mixture of synthetic resins (at least one synthetic resin shall be solid at room temperature) and high boiling point plasticizers. At least one-third of the binder composition shall be 100% maleic-modified glycerol ester of resin and shall be no less than 10% by weight of the entire material formulation. The binder shall contain no petroleum Hydrocarbon resins, tall oil resins or rosins, or any combination of tall oil resins with maleic- modified glycerol esters of rosin.
6. The Hydrocarbon binder shall consist of a mixture of Hydrocarbon resins (at least one Hydrocarbon resin shall be solid at room temperature) and high boiling point plasticizers.
7. The thermoplastic material shall be free of contaminants and shall be dry blended or hot mixed from 100% virgin stock using no reprocessed materials.

8. The thermoplastic material shall be formulated such that when it is on the roadway surface at any natural temperature it exists in a hard, solid state with cold ductility that permits normal movement with the road surface without chipping or cracking.
9. The thermoplastic material shall not deteriorate or discolor when held at the application temperature for periods of time up to 4 hours or upon repeated reheating (a minimum of 4 times).
10. The color, viscosity, and chemical properties versus temperature characteristics of the thermoplastic material shall remain constant for up to 4 hours at the application temperature and shall be the same from batch to batch.
11. The thermoplastic material shall be readily applicable at temperatures between 400 & 440 degrees F from the approved equipment to produce lines and symbols of the required above the pavement thickness.

C. Pavement-Marking Paint

1. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Owner.
2. Allow paving to age for 30 days before starting pavement marking.
3. Sweep and clean surface to eliminate loose material and dust.
4. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

3.8 FIELD QUALITY CONTROL

- A. Contractor is responsible for quality control in accordance with NCDOT's "Hot Mix Asphalt Quality Management System" (HMA/QMS) manual including, but not limited to thickness, smoothness, and in-place density.
- B. Contractor is responsible for providing Owner's Testing Agency with theoretical daily moving average from plant for each day's placement and each mix type placed during that day.
- C. Testing Agency: Owner's Testing Agency will core a minimum of three locations for each day's placement per mix type. The cores will be evaluated by the Owner's Testing Agency for thickness and compaction.
- D. Contractor to replace and compact hot-mix asphalt where core tests were taken.
- E. Remove and replace hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.9 DISPOSAL

- A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.
 1. Do not allow milled materials to accumulate on-site.

END OF SECTION 321216

SECTION 321313 - CONCRETE PAVING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Curbs and gutters.
 - 2. Walks.
- B. Related Sections:
 - 1. Section 033000, "Cast-in-Place Concrete"
 - 2. Section 312000, "Earth Moving"

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.4 SUBMITTALS

- A. Product info: Data, Test Reports, and Material Certifications for each type of product indicated as required in Section 033000.
- B. Furnish drawings indicating jointing pattern proposed for all areas of concrete pavement for approval by the Engineer. Only information completely checked by the manufacturer and the General Contractor will be considered by the Engineer.

1.5 QUALITY ASSURANCE

- A. Products and methods of execution are specified by reference to North Carolina State Department of Transportation and Highway Safety's "Standard Specifications for Roads and Structure" (latest edition). The abbreviation NCDOT is used to designate this publication. Equivalent alternate products and methods of execution as defined by the specifications. All methods and substitutions must be approved by the Engineer.
- B. Testing: The Owner's Testing Agency will evaluate concrete delivered to and placed at the site in accordance with requirements of Section 033000.
- C. Pre-installation Conference: Conduct conference at the Project Site.
 - 1. Review methods and procedures related to concrete paving, including but not limited to, the following:

- a. Concrete mixture design.
 - b. Quality control of concrete materials and concrete paving construction practices.
2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete paving subcontractor.

1.6 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 PRODUCTS

2.1 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces. Forms shall remain in place for a minimum of 24 hours after concrete placement or until concrete is secure. Use straight forms, free of distortion and defects, extending the full depth of concrete. All forms shall receive a form coating the full depth of concrete per Section 033000 of these specifications prior to placing concrete.
 1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less. Do not use notched and bent forms.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.
- C. Automatic Machine Curb and Gutter
 1. Automatic machine may be used for curb and gutter placement at Contractor's option. If machine placement is to be used, Contractor shall submit revised mix design and laboratory test results which meet or exceed minimums specified.
 2. Machine placement must produce curb and gutters to required cross-section, line grades, finish, and jointing as specified for formed concrete. If results are not acceptable, Contractor shall remove and replace with formed concrete as specified.

2.2 STEEL REINFORCEMENT

- A. Recycled Content: Provide steel reinforcement with an average recycled content of steel so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

- B. Plain-Steel Welded Wire Reinforcement: ASTM A-185, fabricated from steel wire into flat sheets.
- C. Tie Bars: ASTM A 615, Grade 60, deformed.
- D. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.
- E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:
 - 1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
 - 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
- F. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.

2.3 CONCRETE MATERIALS

- A. Concrete: Concrete and equipment, workmanship and materials for forming shall conform to applicable requirements of Section 033000, unless otherwise specified. Concrete shall be standard weight with minimum compressive strength as specified on the construction drawings for the various applications.

2.4 CURING MATERIALS

- A. Curing Compound shall be:
 - a. "Clear Bond" by Guardian Chemical Company
 - b. "Sealkure" by Toch Brothers, Inc.
 - c. "Klearseal" by Penn-Dixie or equivalent

2.5 RELATED MATERIALS

- A. Expansion Joint Fillers: Expansion joint fillers shall be ½ inch thick unless otherwise shown on Drawings, equivalent to and shall conform to NCDOT Section 1028:
 - 1. Celotex "Flexcell", "Fibre", by W.R. Meadows
 - 2. "Tex-Lite", by K & P Petroleum Products
 - 3. Sonneborn Sonolastic Sealant
- B. Joint Sealer: Silicone sealant as manufactured by Surebond Inc., WR Meadows, Dow Corning, Silka Corporation or equivalent.

2.6 DETECTABLE WARNING MATERIALS

- A. In accordance with City of Wilmington standards and details.

2.7 CONCRETE MIXTURES

- A. Concrete mixture shall conform to applicable requirements of Section 033000.
- B. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with Owner requirements.

2.8 CONCRETE MIXING

- A. Concrete mixing shall conform to applicable requirements of Section 033000.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.
 - 1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
 - 2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
 - 3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Section 312000 "Earth Moving."
- C. Proceed with installation only after unsatisfactory conditions have been corrected and approved by the Engineer or Owner's Testing Agency.

3.2 PREPARATION

- A. Remove loose material from compacted base or subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- E. Zinc-Coated Reinforcement: Use galvanized-steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.
- F. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963.
- G. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
 - 1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
 - 1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
 - 2. Provide tie bars at sides of paving strips where indicated.
 - 3. Butt Joints: Use a bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 2 inches into concrete.
 - 5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where

indicated.

1. Locate ½ inch expansion joints at intervals of 30 feet unless otherwise indicated.
 2. Extend joint fillers full width and depth of joint.
 3. Terminate joint filler not less than ½ inch or more than 1 inch below finished surface if joint sealant is indicated.
 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. For concrete walks provide contraction joints at 5'-0" (max) o.c., unless otherwise shown on Drawings. For curb and gutter, joints shall be in accordance with the Drawing detail. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.
 - a. Tolerance: Ensure that grooved joints are within 3 inches either way from centers of dowels.
 2. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.
- B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase 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.
- D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
 - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an 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 dislocating reinforcement, dowels, and joint devices.
- H. Screed paving surface with a straightedge and strike off.
- I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing. Curbs shall be true, straight, and of uniform level and slope. All construction shall conform to NCDOT Section 846 and applicable requirements therein. The concrete shall be given a light broom finish with brush marks parallel to the curb line or gutter line.
- K. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.
 - 1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.
- L. Cold-Weather Placement: Refer to Section 033000 "Cast in Place Concrete"
- M. Hot-Weather Placement: Refer to Section 033000 "Cast in Place Concrete"
 - 1. Cool ingredients before mixing to 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 in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 - 3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations. Finishing operations shall conform to the requirement of NCDOT Section 710.

3.8 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.

- C. Evaporation Retarder: Apply evaporation retarder to 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.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Immediately after finishing operations, cure exposed concrete surfaces in accordance with NCDOT Section 700.
- F. After curing, remove debris and backfill area adjoining sidewalk and paving. Grade and compact to conform to surrounding area in accordance with lines and grades indicated on Drawings. Remove damaged concrete that does not drain properly and reconstruct at no additional cost to Owner.

3.9 FIELD QUALITY CONTROL

- A. Sampling: See Section 033000 "Cast-in-Place Concrete" for testing requirements.

3.10 REPAIRS AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Engineer.
- B. Drill test cores where directed by Engineer or Owner's Testing Agency, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with Portland cement concrete bonded to paving with epoxy adhesive. See Section 033000 "Cast-In-Place Concrete" for testing requirements.
- C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

SECTION 329115 - SOIL PREPARATION (PERFORMANCE SPECIFICATION)

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes planting soils specified according to performance requirements of the mixes.
- B. Related Requirements:
 - 1. Section 311000 "Site Clearing" for topsoil stripping and stockpiling.

1.2 DEFINITIONS

- A. CEC: Cation exchange capacity.
- B. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.
- C. Imported Soil: Soil that is transported to Project site for use.
- D. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.
- E. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."
- F. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- G. RCRA Metals: Hazardous metals identified by the EPA under the Resource Conservation and Recovery Act.
- H. SSSA: Soil Science Society of America.
- I. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
- J. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- K. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.

- L. USCC: U.S. Composting Council.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each bulk-supplied material in sealed containers labeled with content, source, and date obtained; providing an accurate representation of composition, color, and texture.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.

PART 2 - PRODUCTS

2.1 PLANTING SOILS SPECIFIED ACCORDING TO PERFORMANCE REQUIREMENTS

- A. Planting-Soil Type: Existing, on-site surface soil, with the duff layer, if any, retained modified to produce viable planting soil. Using preconstruction soil analyses and materials specified in other articles of this Section, amend existing, on-site surface soil to become planting soil complying with the following requirements:
 - 1. ASTM D 5862
 - 2. Percentage of Organic Matter: Minimum 6 percent by volume.
 - 3. Soil Reaction: pH of 5.5 to 7.
- B. Planting-Soil Type: Imported, naturally formed soil from off-site sources and consisting of sandy loam according to USDA textures; and modified to produce viable planting soil. Amend imported soil with materials specified in other articles of this Section to become planting soil complying with the following requirements:
 - 1. ASTM D 5862

2. Sources: Take imported, unamended soil from sources that are naturally well-drained sites where topsoil occurs at least 4 inches (100 mm) deep, not from agricultural land, bogs, or marshes; and that do not contain undesirable organisms; disease-causing plant pathogens; or obnoxious weeds and invasive plants including, but not limited to, quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and brome grass.
 3. Additional Properties of Imported Soil before Amending: Minimum of 6 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration. Clean soil to be of the following:
 - a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
 - b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 8 percent by dry weight of the imported soil.
 - c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 1 inch in any dimension.
- C. Planting-Soil Type: Manufactured soil consisting of manufacturer's basic topsoil, blended in a manufacturing facility with sand, stabilized organic soil amendments, and other materials as specified in other articles of this Section to produce viable planting soil.
1. Basic Properties: Manufactured soil shall not contain the following:
 - a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
 - b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 5 percent by dry weight of the manufactured soil.
 - c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 1 inch in any dimension.
 2. Percentage of Organic Matter: Minimum 6 percent by volume.
 3. Soil Reaction: pH of 5.5 to 7.

2.2 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent.
- B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent elemental sulfur, with a minimum of 99 percent passing through a No. 6 (3.35-mm) sieve and a maximum of 10 percent passing through a No. 40 (0.425-mm) sieve.

- C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- D. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through a No. 50 (0.30-mm) sieve.
- E. Sand: Clean, washed, natural or manufactured, free of toxic materials, and according to ASTM C33/C33M.

2.3 ORGANIC SOIL AMENDMENTS

- A. Compost: Well-composted, stable, and weed-free organic matter produced by composting feedstock, and bearing USCC's "Seal of Testing Assurance," and as follows:
 - 1. Feedstock: Limited to leaves.
 - 2. Reaction: pH of 5.5 to 8.
 - 3. Soluble-Salt Concentration: Less than 4 dS/m.
 - 4. Moisture Content: 35 to 55 percent by weight.
 - 5. Organic-Matter Content: 50 to 60 percent of dry weight.
 - 6. Particle Size: Minimum of 98 percent passing through a 3/4-inch sieve.
- B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or of granular texture, a pH of 3.4 to 4.8, and a soluble-salt content measured by electrical conductivity of maximum 5 dS/m.
- C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, a pH of 6 to 7.5, a soluble-salt content measured by electrical conductivity of maximum 5 dS/m, having a water-absorbing capacity of 1100 to 2000 percent, and containing no sand.
- D. Wood Derivatives: Shredded and composted, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.
- E. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.4 FERTILIZERS

- A. Superphosphate: Commercial, phosphate mixture, soluble.
- B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium.
- C. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium.

PART 3 - EXECUTION

3.1 GENERAL

- A. Place planting soil and fertilizers according to requirements in other Specification Sections.
- B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.

3.2 PREPARATION OF UNAMENDED, ON-SITE SOIL BEFORE AMENDING

- A. Excavation: Excavate soil from designated area(s) to a depth of 8 inches and stockpile until amended.
- B. Unacceptable Materials: Clean soil of concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
- C. Unsuitable Materials: Clean soil to contain a combined maximum of 8 percent by dry weight of stones, roots, plants, sod, clay lumps, and pockets of coarse sand.
- D. Screening: Pass unamended soil through a 2-inch sieve to remove large materials.

3.3 PLACING AND MIXING PLANTING SOIL OVER EXPOSED SUBGRADE

- A. General: Apply and mix unamended soil with amendments on-site to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.
- B. Subgrade Preparation: Till subgrade to a minimum depth of 8 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
- C. Mixing: Spread unamended soil to total depth of 3 inches, but not less than required to meet finish grades after mixing with amendments and natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.
 - 1. Amendments: Apply soil amendments and fertilizer, if required, evenly on surface, and thoroughly blend them with unamended soil to produce planting soil.
 - a. Mix lime and sulfur with dry soil before mixing fertilizer.
 - b. Mix fertilizer with planting soil no more than seven days before planting.

2. Lifts: Apply and mix unamended soil and amendments in lifts not exceeding 8 inches in loose depth for material compacted by compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

- D. Compaction: Compact each blended lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D698.
- E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.4 PLACING MANUFACTURED PLANTING SOIL OVER EXPOSED SUBGRADE

- A. General: Apply manufactured soil on-site in its final, blended condition. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.
- B. Subgrade Preparation: Till subgrade to a minimum depth of 8 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
- C. Application: Spread planting soil to total depth of 3 inches, but not less than required to meet finish grades after natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.
 1. Lifts: Apply planting soil in lifts not exceeding 8 inches in loose depth for material compacted by compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- D. Compaction: Compact each lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D698.
- E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.5 BLENDING PLANTING SOIL IN PLACE

- A. General: Mix amendments with in-place, unamended soil to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.
- B. Preparation: Till unamended, existing soil in planting areas to a minimum depth of 8 inches. Remove stones larger than 1-inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
- C. Mixing: Apply soil amendments and fertilizer, if required, evenly on surface, and thoroughly blend them into full depth of unamended, in-place soil to produce planting soil.
 1. Mix lime and sulfur with dry soil before mixing fertilizer.
 2. Mix fertilizer with planting soil no more than seven days before planting.

- D. Compaction: Compact blended planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D698 except where a different compaction value is indicated on Drawings.
- E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.6 APPLYING COMPOST TO SURFACE OF PLANTING SOIL

- A. Application: Apply compost component of planting-soil mix to surface of in-place planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.
- B. Finish Grading: Grade surface to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform the following tests and inspections:
 - 1. Compaction: Test planting-soil compaction after placing each lift and at completion using a densitometer or soil-compaction meter calibrated to a reference test value based on laboratory testing according to ASTM D698. Space tests at no less than one for each 2000 sq. ft. of in-place soil or part thereof.
 - 2. Performance Testing: For each amended planting-soil type, demonstrating compliance with specified performance requirements. Perform testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.
- C. Soil will be considered defective if it does not pass tests.
- D. Prepare test reports.
- E. Label each sample and test report with the date, location keyed to a site plan or other location system, visible conditions when and where sample was taken, and sampling depth.

3.8 PROTECTION AND CLEANING

- A. Protection Zone: Identify protection zones according to Section 015639 "Temporary Tree and Plant Protection."
- B. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:
 - 1. Storage of construction materials, debris, or excavated material.

2. Parking vehicles or equipment.
 3. Vehicle traffic.
 4. Foot traffic.
 5. Erection of sheds or structures.
 6. Impoundment of water.
 7. Excavation or other digging unless otherwise indicated.
- C. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.
1. Dispose of excess subsoil and unsuitable materials on-site where directed by Owner.

END OF SECTION 329115

SECTION 329200 - TURF AND GRASSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Seeding.
2. Sodding.

1.2 DEFINITIONS

- A. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.
- B. Finish Grade: Elevation of finished surface of planting soil.
- C. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- D. NCDOT: North Carolina Department of Transportation
- E. NCDEQ - DEMLR: North Carolina Department of Environmental Quality - Division of Energy, Mineral, and Land Resources.
- F. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- G. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- H. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- I. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.
- J. Subsoil: All soil beneath the topsoil layer of the soil profile and typified by the lack of organic matter and soil organisms.

- K. Surface Soil: Whatever soil is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Certification of grass seed.
 - 1. Certification of each seed mixture.
- C. Product certificates of conformance
 - 1. Seed
 - 2. Sod
 - 3. Fertilizer
 - 4. Soil Amendments
 - 5. Soil
 - 6. Mulch
 - 7. Erosion Control Materials
 - 8. Pesticides
 - 9. Herbicide

1.4 QUALITY ASSURANCE

- A. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 - 1. Pesticide Applicator: State licensed, commercial.
- B. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory.
 - 1. The soil-testing laboratory shall oversee soil sampling.
 - 2. Recommended Soil Testing Laboratory: NC Department of Agriculture
 - 3. Report suitability of tested soil for turf growth.
 - a. State recommendations for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
 - b. Report presence of problem salts, minerals, or heavy metals; if present, provide additional recommendations for corrective action.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Seed: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and

federal laws, as applicable. Label in conformance with the USDA Federal Seed Act, any other statutes, rules and regulations and applicable state seed laws. Wet, moldy, or otherwise damaged seed will be rejected.

- B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage and drying.
- C. Fertilizer and Lime: Deliver materials to the site in the original, unopened containers bearing the manufacturer's chemical analysis, name, trade name, trademark, and indication of conformance to state and federal laws. In lieu of containers, furnish fertilizer and lime in bulk with a certificate indicating the information described above with each delivery

1.6 MAINTENANCE SERVICE

- A. Initial Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until acceptable turf is established but for not less than the following periods:
 - 1. Seeded Turf: 30 days from date of planting completion
 - 2. Sodded Turf: 30 days from date of planting completion
 - 3. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.

PART 2 - PRODUCTS

2.1 SEED

- A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.
- B. Permanent Grass Seed Species: State-certified seed of grass species of the latest season's crop as follows:
 - a. Certified Princess 77 Bermudagrass or other as approved by owner.
- C. Temporary Grass Seed Mix: Proprietary seed mix as follows:
 - 1. Products: Subject to compliance with NCDEQ and NCDOT erosion control requirements, provide the following according to season of planting.
 - a. Late Winter – Early Spring (Feb 1 – May 1): Annual Ryegrass
 - b. Summer (Apr 15-Aug 15): German Millet

- c. Fall (Aug 15 – Dec 30): Annual Ryegrass

2.2 TURFGRASS SOD

- A. Turfgrass Sod: Certified and complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.
- B. Turfgrass Species: Sod of grass species as follows:
 - a. Bermuda Type 419 "Tifway" or other as approved by owner.

2.3 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
 - 1. Class: T, with a minimum of 99 percent passing through No. 8 (2.36-mm) sieve and a minimum of 75 percent passing through No. 60 (0.25-mm) sieve.
 - 2. Class: O, with a minimum of 95 percent passing through No. 8 (2.36-mm) sieve and a minimum of 55 percent passing through No. 60 (0.25-mm) sieve.
- B. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, and with a minimum of 99 percent passing through No. 6 (3.35-mm) sieve and a maximum of 10 percent passing through No. 40 (0.425-mm) sieve.
- C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- D. Aluminum Sulfate: Commercial grade, unadulterated.
- E. Perlite: Horticultural perlite, soil amendment grade.
- F. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 (0.30-mm) sieve.
- G. Sand: Clean, washed, natural or manufactured, and free of toxic materials.
- H. Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent water absorption capacity by weight.
- I. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.4 ORGANIC SOIL AMENDMENTS

- A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch (25-mm)

sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings.

- B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or of granular texture, with a pH range of 3.4 to 4.8.
- C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, with a pH range of 6 to 7.5, and having a water-absorbing capacity of 1100 to 2000 percent.
- D. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.
- E. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.

2.5 FERTILIZERS

- A. Fertilizer shall be delivered in unopened, original containers each bearing the manufacturer's guaranteed analysis. Fertilizer shall be commercial grade, free flowing, and uniform in composition. Any fertilizer which becomes caked or otherwise damaged shall not be accepted.
- B. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 4 percent nitrogen and 20 percent phosphoric acid.
- C. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.
- D. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
 - 1. Composition: 1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m) of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
- E. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - 1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.

2.6 PLANTING SOILS

- A. Planting Soil: ASTM D 5268 topsoil with pH range of 5.5 to 7 and a minimum of 2 percent organic material content, or existing native surface topsoil formed under natural conditions with the duff layer retained during excavation process, or existing in-place surface soil, or imported topsoil or manufactured topsoil from off-site sources. Do not obtain from agricultural land, bogs or marshes. Verify suitability of soil to produce viable planting soil. Clean soil of roots, plants,

sod, stones, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth. Mix soil with the following soil amendments and fertilizers according to soil analysis results and recommendations to produce planting soil.

2.7 MULCHES

- A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley at 4,000lb/ac.
- B. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch (25-mm) sieve; soluble salt content of 2 to 5 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings.

2.8 PESTICIDES

- A. General: Pesticide, registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

2.9 HERBICIDES

- A. Non-selective 41% Glyphosate product.

PART 3 - EXECUTION

3.1 TURF AREA PREPARATION

- A. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 4 inches (100 mm). Remove stones larger than 1 inch (25 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 - 1. Apply fertilizer directly to subgrade before loosening.
 - 2. Thoroughly blend planting soil off-site before spreading or spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil.
 - 3. Spread planting soil to a depth of 4 inches (100 mm) but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
 - a. Reduce elevation of planting soil to allow for soil thickness of sod.
- B. Unchanged Subgrades: If turf is to be planted in areas unaltered or undisturbed by excavating, grading, or surface-soil stripping operations, prepare surface soil as follows:

1. Remove existing grass, vegetation, and turf. Do not mix into surface soil.
 2. Loosen surface soil to a depth of at least 4 inches (150 mm). Apply soil amendments and fertilizers according to planting soil mix proportions and mix thoroughly into top 4 inches (100 mm) of soil. Till soil to a homogeneous mixture of fine texture.
 - a. Apply fertilizer directly to surface soil before loosening.
 3. Remove stones larger than 1 inch (25 mm) in any dimension and sticks, roots, trash, and other extraneous matter.
 4. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.
- C. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch (13 mm) of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.
- D. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- E. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.2 SEEDING

- A. Seeded areas shall be hydro seeded, except small areas that are inaccessible to the hydro seeding equipment, which shall be drill seeded
- B. Do not broadcast or drop seed when wind velocity exceeds 5 mph (8 km/h). Evenly distribute seed by sowing equal quantities in two directions at right angles to each other. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.
- C. Sow temporary seeding at a total rate of:
1. Late Winter and Early Spring, Annual Rye: (Jan. 1 – Apr. 15): 120 lb./ac.
 2. Summer, German Millet (Apr. 15 – Aug. 15): 50 lb./ac
 3. Fall, Annual Rye (Aug. 15 – Dec. 30): 120 lb./ac.
- D. Sow permanent seeding at a rate of:
1. Princess 77 Bermuda Grass: 90 lb./ac.
- E. Rake seed lightly into top 1/8 inch (3 mm) of soil, roll lightly, and water with fine spray.
- F. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 75 lb./1,000 sf to form a continuous blanket 1-1/2 inches (38 mm) in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.
1. Anchor straw mulch by crimping into soil with vertical set blade or other suitable mechanical equipment.
- G. Watering:

1. The mulched and seeded areas shall be sprinkled with water applied in a light spray until the seedbed is thoroughly moist to a depth of 1 inch.
2. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches. Sprinkling shall be continued during dry weather to ensure a good stand of grass.

H. Mowing

1. Mowing of the seeded areas shall be the responsibility of the Contractor within the establishment period with approved mowing equipment to a height of two (2) inches when average height of grass becomes three (3) inches.

3.3 SODDING

- A. Entire area to be sodded should be sprayed with the non-selective 41% Glyphosate product. Allow at least forty-eight (48) hours post – herbicide application before tilling and grading begins.
- B. Prepare area according to TURF AREA PREPARATION specification.
- C. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.
- D. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
 1. Lay sod across angle of slopes exceeding 1:3.
 2. Anchor sod on slopes exceeding 1:6 with wood pegs spaced as recommended by sod manufacturer but not less than 2 anchors per sod strip to prevent slippage.
- E. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches (38 mm) below sod.
- F. Grades on the areas to be sodded that have been established previously shall be maintained in a true and even condition.

3.4 TURF MAINTENANCE

- A. The Contractor shall be responsible for the care of the sodded areas while grass is becoming established.
- B. The establishment period shall be one month with adequate average temperature for germination or knitting to occur or as required to obtain a complete stand of mowable grass which is acceptable to the owner.

- C. Immediately after seeding and sodding operations, protect the areas against traffic and other uses by erecting barricades, as required, and by placing approved signs at appropriate intervals until final acceptance by the owner
- D. Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and re-mulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
- E. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain height appropriate for species without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings.
- F. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

3.5 SATISFACTORY TURF

- A. Turf installations shall meet the following criteria as determined by Architect:
 - 1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. (0.92 sq. m) and bare spots not exceeding 5 by 5 inches (125 by 125 mm).
 - 2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.
- B. Use specified materials to reestablish turf that complies with requirements and continue maintenance until turf is satisfactory.

END OF SECTION 329200

SECTION 329300 - PLANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Plants.
 - 2. Tree-watering devices.

1.2 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides.
- C. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329115 "Soil Preparation (Performance Specification)" for drawing designations for planting soils.
- D. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples of each type of mulch.

1.5 INFORMATIONAL SUBMITTALS

- A. Product certificates.

- B. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year.

1.7 QUALITY ASSURANCE

- A. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 - 1. Pesticide Applicator: State licensed, commercial.
- B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver bare-root stock plants within 24 hours of digging. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting. Transport in covered, temperature-controlled vehicles, and keep plants cool and protected from sun and wind at all times.
- B. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.
- C. Handle planting stock by root ball.
- D. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1.9 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
 - 1. Failures include, but are not limited to, the following:

- a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
 - b. Structural failures including plantings falling or blowing over.
2. Warranty Periods: 1 year after the date of substantial completion.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
- B. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

2.2 FERTILIZERS

- A. Planting Tablets: Tightly compressed chip-type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.
 1. Size: 5-gram tablets.
 2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

2.3 MULCHES

- A. Organic Mulch: Shredded hardwood.

2.4 PESTICIDES

- A. General: Pesticide registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

2.5 TREE-WATERING DEVICES

- A. Slow-Release Watering Device: Standard product manufactured for drip irrigation of plants and emptying its water contents over an extended time period; manufactured from UV-light-stabilized nylon-reinforced polyethylene sheet, PVC, or HDPE plastic.

PART 3 - EXECUTION

3.1 PLANTING AREA ESTABLISHMENT

- A. General: Prepare planting area for soil placement and mix planting soil according to Section 329115 "Soil Preparation (Performance Specification)."
- B. Placing Planting Soil: Place manufactured planting soil over exposed subgrade.
- C. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.2 EXCAVATION FOR TREES AND SHRUBS

- A. Planting Pits and Trenches: Excavate circular planting pits.
 - 1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
 - 2. Excavate approximately three times as wide as ball diameter.
 - 3. Excavate at least 12 inches (300 mm) wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
 - 4. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
- B. Backfill Soil: Subsoil and topsoil removed from excavations may not be used as backfill soil unless otherwise indicated.

3.3 TREE, SHRUB, AND VINE PLANTING

- A. Inspection: At time of planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.
- B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

- C. Set each plant plumb and in center of planting pit or trench with root flare 1 inch above adjacent finish grades.
 - 1. Backfill: Planting soil or for trees, use amended excavated soil for backfill.
 - 2. Balled and Burlapped Stock: After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 - 3. Balled and Potted and Container-Grown Stock: Carefully remove root ball from container without damaging root ball or plant.
 - 4. Fabric Bag-Grown Stock: Carefully remove root ball from fabric bag without damaging root ball or plant. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 - 5. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
 - 6. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole.
 - a. Quantity: Three for each caliper inch of plant.
 - 7. Continue backfilling process. Water again after placing and tamping final layer of soil.
- D. Slopes: When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.4 TREE, SHRUB, AND VINE PRUNING

- A. Remove only dead, dying, or broken branches. Do not prune for shape.
- B. Prune, thin, and shape trees, shrubs, and vines as directed by Architect.
- C. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.
- D. Do not apply pruning paint to wounds.

3.5 GROUND COVER AND PLANT PLANTING

- A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated on Drawings in even rows with triangular spacing.
- B. Use planting soil for backfill.

- C. Dig holes large enough to allow spreading of roots.
- D. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- E. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- F. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.6 PLANTING AREA MULCHING

- A. Mulch backfilled surfaces of planting areas and other areas indicated.
 - 1. Organic Mulch in Planting Areas: Apply 3-inch average thickness of organic mulch over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 6 inches of trunks or stems.

3.7 INSTALLING SLOW-RELEASE WATERING DEVICE

- A. Provide one device for each tree.

3.8 PLANT MAINTENANCE

- A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.
- B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
- C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.
- D. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- E. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- F. At time of Substantial Completion, verify that tree-watering devices are in good working order and leave them in place. Replace improperly functioning devices.

3.9 MAINTENANCE SERVICE

- A. Maintenance Service: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:
 - 1. Maintenance Period for Trees and Shrubs: 12 months from date of substantial completion.

END OF SECTION 329300

SECTION 33 11 16 - FACILITY WATER DISTRIBUTION

PART 1 GENERAL

1.1 GENERAL NOTES

- A. Work in this section includes exterior water piping and appurtenances for fire main and domestic service at and below the finished grade and up to 5 feet outside the limits of the building. All service connections to the building to be plugged and marked.
- B. All structures, related piping and accessories shall be in accordance with the standards of the North Carolina Department of Public Health, National Fire Protection Association, National Standard Plumbing Code, and supplemented with any applicable Cape Fear Public Utility Authority standards. If discrepancies exist they should be brought to the Engineer's attention immediately.
- C. Refer to construction drawings for number, location and details of all proposed structures and pipes.
- D. Pipes 4 inches and larger shall be Ductile Iron unless otherwise specified.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Materials, Installation, and Testing shall be in accordance with Cape Fear Public Utility Authority and Owner standards and specifications.

1.3 SUMMARY

- A. Section includes but not limited to the following items and appurtenances shown on drawings and specified in this Section:
 - 1. Plastic Pipe (PVC & HDPE).
 - 2. Ductile Iron Pipe.
 - 3. Fittings and Specials.
 - 4. Fire Hydrants.
 - 5. Valves.
 - 6. Indicator Posts.
 - 7. Protective Enclosures.
 - 8. Service Connection Pipe and Fittings.

9. Tapping Sleeve and Valves.
10. Pipe Location Wire.
11. Backflow Preventers.
12. Protective Backflow Enclosures.
13. 2" Blow-off Assembly

B. Related Sections: The following Sections contain requirements that relate to the Section:

1. Division 31, Section "Trenching"
2. Division 31, Section "Dewatering"

1.4 DEFINITIONS

- A. PVC: Polyvinyl Chloride Pipe.
- B. DIP: Ductile Iron Pipe.
- C. CFPUA: Cape Fear Public Utility Authority
- D. HDPE: High Density Polyethylene Pipe.

1.5 SUBMITTALS

- A. Product Data: Manufacturer information describing part, accessories, connections and any standard details.
- B. Manufacturer's Instructions: Special procedures required to install specified products.
- C. Shop Drawings: Indicate Part Sizes, connection sizes, elevations and connection parts.
- D. Manufacturer's Certificate: Products meet or exceed specified requirements.
- E. Qualifications Statements:
 1. Qualifications for manufacturer, and installer.
 2. Manufacturer's approval of installer.
- F. Field quality-control reports.
- G. Project Record Documents: Record actual locations of valves, post-indicators, joints with changes in direction, hydrants, pipe and elevations.
- H. Operation and Maintenance Data: Submit any special requirements for maintenance.

1.6 QUALITY ASSURANCE

- A. Perform Work according to Construction Drawings, Cape Fear Public Utility Authority and Owner standards.
- B. Fabricator: Company specializing in fabricating products specified in this Section with three years' experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect pipe, pipe fittings, and seals from dirt and damage.
- B. Store according to manufacturer's instructions.
- C. Protect any UV sensitive materials from sunlight by using manufacturer recommendations.

1.8 PROJECT CONDITIONS

- A. Interruption of any existing Water Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Owner's Representative no fewer than (72) hours in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of service without Owner's Representative's written permission
- B. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 PLASTIC PIPE AND FITTINGS

- A. HDPE Pipe shall be 2 inch minimum, SDR 9, and rated for 200 psi working pressure.
- B. PVC Pipe sized 2 inches shall be per ASTM D2241, IPS, Gasketed Pipe, SDR 21 minimum and shall bear the seal of NSF.
- C. PVC Pipe sizes 4 inches through 12 inches shall conform to AWWA C900 Class 150 (DR 18). Pipe shall bear the seal of NSF. Joints shall conform to ASTM D3139 or ASTM D3212.

2.2 DUCTILE IRON PIPE AND FITTINGS

- A. Ductile iron pipe shall conform to ANSI/AWWA C150/A21.50, ANSI/AWWA C151/A21.51, thickness class 52.
- B. DIP shall have a minimum pressure rating of 350 psi, with asphalt coating and cement mortar lining unless otherwise shown or specified.
- C. Joints shall be push-on or mechanical joints conforming to ANSI/AWWA C111/A21.11, with a minimum pressure rating of 350 psi, with a minimum safety factor of 2:1.

- D. Linings for pipe and fittings shall be standard thickness cement-mortar in accordance with ANSI/AWWA C104/A21.4.
- E. Outside coating shall be a minimum of 1 mil bituminous paint according to ANSI/AWWA C151/A21.51.

2.3 FITTINGS AND SPECIALS

- A. Fittings and specials shall be Thickness Class 52 ductile iron, mechanical joint in accordance with ANSI/AWWA C111/A21.11, ANSI/AWWA C153/A21.53, 150 pounds per square inch pressure rating unless otherwise specified, except that the profile of the bell may have special dimensions as required by the pipe manufacturer with elastomeric gaskets. Ductile iron fittings and specials shall be cement-mortar lined (standard thickness) in accordance with ANSI/AWWA C104/A21.4. Fittings shall be for bell and spigot pipe.
- B. Buried service fittings and specials shall be suitable for 350 psi working pressure. Fittings and specials for mechanical joint pipe shall conform to C153/A21.53.
- C. Above ground service fittings (valve vaults, valve pits, etc.) shall be rated for 250 psi working pressure.

2.4 HYDRANTS

- A. Hydrants shall be iron body, fully bronze mounted, dry barrel type with breakaway flange and stem coupling conforming to AWWA C502.
- B. Hydrant to have a valve opening not less than 4-1/2 inches in diameter.
- C. Hydrant shall have a 6-inch mechanical joint connection on the inlet end.
- D. Outlets shall have one 5 inch STORZ connection and two 2-1/2 inch American National Standard fire hose coupling threads.
- E. All working parts shall be bronze.
- F. Hydrant shall be a Mueller, American Darlings, Clow or approved equal.

2.5 VALVES

- A. Valves shall be iron body, bronze mounted, double disc, parallel seat type meeting the full requirements of AWWA C500, or resilient valves in conformance with AWWA C509 or C515.
- B. Valve shall have a 2-inch operating nut, open left and shall have O-ring seals.
- C. Valve ends shall be mechanical joint, unless otherwise shown or specified.
- D. The valve bonnet shall have 316 stainless steel fasteners.
- E. Valve coating shall conform to AWWA C550 and ANSI/NSF 61.
- F. Valve shall be a Mueller, American Darling, Clow or approved equal.

2.6 INDICATOR POSTS

- A. Indicator posts shall be UL 789, FM-approved, vertical type with cast-iron body and operating wrench, contain an extension rod and an adjustable cast-iron barrel of length required for depth of bury of valve.

2.7 PROTECTIVE ENCLOSURES

- A. Square nut valve boxes shall be cast iron screw adjustment type with flared base. The word "WATER" shall be cast into the cover.
- B. The valve box shall be of such length as will be adapted, without full extension, to the depth of cover required over the pipe at the valve locations.
- C. Boxes shall be installed over each gate valve, and shall conform to ASTM A48 "Grey Iron Castings" Class 30B or approved equal.
- D. Valve boxes in unpaved areas shall be installed with either a pre-cast or poured in place concrete collar.

2.8 SERVICE CONNECTION PIPE AND FITTINGS

- A. Service line shall be in accordance with Construction Drawings, CFPUA and Owner requirements.
- B. Service line shall be 2-inch Polyethylene (PE) tubing, SDR 9, 200 psi working pressure rating, conforming to ASTM D2737/AWWA C901.
- C. Corporation stops shall be a ball valve type, have a 300 psig working pressure and in conformance with AWWA/ANSI C800. Stop to be installed perpendicular to main.
- D. Service saddles for PVC mains shall be wide band, 2 piece brass body. Saddle shall be McDonald 3801 Series, Ford S90 (double strap), Mueller Series H-13000 bronze body or approved equal. No three piece service saddles are permitted.
- E. Service tapping valve shall be a 2 inch Resilient Wedge Gate Valve.
- F. Service valve to be provided with a valve box in accordance with 2.7 Protective Enclosures.

2.9 PIPE LOCATION WIRE

- A. Pipe locator wire shall be installed on all main lines, hydrant legs and services.
- B. Locator wire to be a 10 gauge insulated copper wire rated for underground waterproof application.
- C. Splices in the wire shall be made with an underground rated, watertight splice connector.

2.10 TAPPING SLEEVE AND VALVES

- A. Service taps shall be per CFPUA standard specifications, Section 02660, "Water Distribution System".

- B. Sleeve shall be cast iron or stainless steel 150 psi working pressure, mechanical joint.
- C. Valves shall be open right vertical type with “O” rings seals, mechanical joint outlet end and flange end for connection to tapping sleeve and furnished with a valve box.
- D. Flange end shall have machined projections to ensure correct alignment.
- E. Seat opening of valve shall be slightly larger than nominal size to provide for full diameter cut to be made.
- F. Sleeve shall be furnished by valve manufacturer.

2.11 BACKFLOW PREVENTERS

- A. The CFPUA Cross Connection and Backflow Prevention Ordinance lists the types of backflow prevention assemblies required for different applications.
- B. General: Manufactured backflow preventers, of size indicated for maximum flow rate and maximum pressure loss indicated as allowed.
- C. Working Pressure: 150 psig (1035 kPa) minimum, unless otherwise indicated.
- D. 2-Inch NPS (DN50) and Smaller: Bronze body with threaded ends.
- E. 2-1/2-Inch NPS (DN65) and Larger: Bronze, cast-iron, steel, or stainless-steel body with flanged ends.
- F. Interior Lining: AWWA C550, epoxy coating for backflow preventers with cast-iron or steel body.
- G. Interior Components: Corrosion-resistant materials.
- H. Strainer on inlet if strainer is indicated.
- I. Hose-Connection Vacuum Breakers: ASSE 1011, nickel plated, with nonremovable and manual drain features, and ASME B1.20.7, 3/4-11.5NH threads for garden hose on outlet. Units attached to rough-bronze-finish hose connections may be rough bronze.
- J. Reduced-Pressure Detector Assembly Backflow Preventers: ASSE 1047, FM approved or UL listed, with OS&Y gate valves on inlet and outlet, and strainer on inlet. Include pressure-differential relief valve with ASME A112.1.2 air-gap fitting located between 2 positive-seating check valves, test cocks, and bypass with displacement-type water meter, valves, and reduced-pressure backflow preventer, for continuous-pressure application.
- K. Pressure Loss: 12 psig (83 kPa) maximum through middle third of flow range.

2.12 PROTECTIVE BACKFLOW ENCLOSURES

- A. Description: Manufactured, weather-resistant and freeze-proof enclosure, meeting ASSE 1060 standards, and designed to protect aboveground water piping equipment or specialties. Include size and dimensions indicated, but not less than those required for access and service of protected unit and the following:

1. Housing: Reinforced-fiberglass construction.
2. Drain opening for units with drain connection.
3. Access doors with locking devices.
4. Insulation inside housing.
5. Electric heating cable or heater with self-limiting temperature control.
6. Precast or cast-in-place concrete base of dimensions required to extend at least 6 inches (150 mm) beyond edges of housing.
7. Anchoring devices to attach housing to base.

2.13 BLOW-OFF ASSEMBLY

- A. Device is used for manual operation of periodic discharge of the waterline at the termination point. Assembly shall be installed in conformance with CFPUA "2" Blow-Off" Detail Standard.

2.14 HEAT TRACE

- A. Self-regulating type, 2 tinned-copper bus wires, self-regulating polymer core maintaining temperature of pipe above freezing. Cover heater with polyolefin dielectric jacket, tinned-copper braid jacket and outer polyolefin jacket. Heater shall be compatible with 208, single phase electrical power without transformers.
- B. Include power connection kits, tee kits, end seal kits, splice kits, and transformers by same manufacturer as heater. Include fiberglass tape or cable ties to fasten heater to pipe.
- C. Automatic control with stainless steel bulb on 10 ft capillary or Stainless steel air temperature sensor, set at 45F with adjustable range of 25 to 325F.
- D. Manufactured by Raychem, Dekoron, Thermon or approved equal.

2.15 INSULATION

- A. 1.5" rigid fiberglass with minimum nominal density of 3 lb/ft³ and thermal conductivity of not more than 0.23 at 75°F mean temperature.
- B. Johns Manville Micro-Lok 850, Owens Corning Fiberglas ASJ/SSL-II or equivalent by listed manufacturer.
- C. Pre insulated pipe support at hanger locations similar to Pipe Shields model A2000, A4000, A9000, D3000 and D3200
- D. 0.016" thick, stucco embossed outer aluminum jacket with integrally bonded polykraft moisture barrier. Seam to face down.

PART 3 EXECUTION

3.1 EARTHWORK

- A. Excavation, trenching, and backfilling are specified in Division 31 Section "Trenching."

3.2 EXAMINATION

- A. Verify that excavations, dimensions and elevations are as indicated.
- B. Check pipes for cracks or other compromising features.
 - 1. Any irregularities shall be reported and approved prior to installation.

3.3 PREPARATION

- A. Correct over-excavation with coarse aggregate.

3.4 PIPING INSTALLATION

- A. Install pipe in strict conformance with AWWA C600. Install plastic pipe in conformance with ASTM D2774 and recommended practices of the UNI-BELL Plastic Pipe Association.

3.5 CUTTING OF PIPE

- A. Cut pipe in a neat and workmanlike manner without damage to the pipe or its lining.

3.6 JOINT DEFLECTION

- A. Maximum joint deflections shall meet the requirements of AWWA C600 or AWWA Manual of Practice M23.

3.7 JOINTING OF PIPE

- A. Precautions shall be taken to protect pipe interiors, fittings and valves against contamination. Pipe delivered for construction shall be strung so as to minimize entrance of foreign material.
- B. When pipe laying is not in progress all openings in the pipeline shall be closed by water-tight plugs. Joints of all pipe in trench shall be completed before work is stopped.
- C. Install all pipe and pipe joints in accordance with AWWA C600 and as manufacturer recommends.

3.8 SETTING OF VALVES AND VALVE BOXES

- A. Install where shown or directed and set plumb on a brick foundation. Valve boxes shall be centered on the valves. Boxes shall be installed over each outside gate valve. Where feasible, valves shall be located outside the area of roads and streets. Earth fill shall be carefully tamped around each valve box to a distance of 4 feet on all sides of the box, or to the undisturbed trench face if less than 4 feet.
- B. Valves after delivery shall be drained to prevent freezing and shall have the interiors cleaned of all foreign matter before installation. Valves shall be fully opened and fully closed to insure that all parts are in working condition.

3.9 FIRE HYDRANT INSTALLATION

- A. Locate and install as shown on the drawings. Each hydrant shall be connected to the main with a 6-inch branch line.
- B. Hydrants shall be set plumb with the pumper nozzle facing the roadway and with the center of the lowest outlet not less than 18 inches above the finished surrounding grade and the operating nut not more than 48 inches above the finished surrounding grade.
- C. The hydrant shall be set in a bed of crushed rock which shall surround the barrel at least 12 inches in all directions.
- D. Hydrants shall be restrained with 316 stainless steel tie rods extending from the main line tee to the hydrant, or by combination of tie rods and blocking or by “Megalug” retainer glands at each joint per manufacturer’s requirements.
- E. Hydrant valves shall be located at the main as close to the tee or tap as possible, 18” maximum.

3.10 RESTRAINING AND BLOCKING

- A. The plugs, caps, tees and bends deflecting 11 1/4 degrees or more either vertically or horizontally on water lines 6 inches in diameter or larger shall be provided with thrust blocking or “Megalug” or Camlok retainer gland at each joint, installed per manufacturer’s requirements.
- B. Blocking shall be placed between solid ground and the fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of the thrust blocks shall be poured directly against undisturbed earth, with a blocking cure time of 5 days. The sides of thrust blocks not subject to thrust may be poured against forms.
- C. The area of bearing shall be as shown on the plans or as directed. Blocking shall be placed so that the fitting joints will be accessible for repair. Rods and clamps shall be 316 stainless steel.

3.11 BACKFLOW PREVENTER INSTALLATION

- A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to plumbing and health department authorities having jurisdiction.
- B. Do not install reduced-pressure-principle type in pit. Use above ground enclosure appropriately sized.
- C. Do not install bypass around backflow preventer.
- D. Support backflow preventers, valves, and piping on brick or concrete piers.
- E. Install tamper switches.
- F. Assembly shall be installed at least twelve inches above the finished grade, flood level, or floor with a maximum height elevation of sixty inches.
- G. There shall be twelve inches clearances on all sides of the assembly.

- H. Electrical equipment, outlets and breaker boxes shall not be located beneath the assembly.
- I. Assembly shall be approved by the USC Foundation for Cross Connection Control or ASSE.

PART 4 FIELD QUALITY CONTROL

4.1 HYDROSTATIC TESTING

- A. Testing shall be in accordance with all CFPUA Standards and Specifications.
- B. After all piping and appurtenances are installed and where any section of a water line is provided with a concrete thrust blocking, the hydrostatic test shall not be made until at least 5 days after installation of the concrete thrust blocking unless otherwise approved.
- C. The method proposed for disposal of wastewater from hydrostatic tests and disinfection shall be submitted to the Owner's representative prior to performing hydrostatic tests. Use clean potable water for all testing.
- D. For purposes of testing, working pressure shall be 100 psi and test pressure shall be 150 psi. The pressure gauge must be liquid filled with 2 psi increments maximum and a minimum of 3 feet above grade. No more than 3 psi can be lost during the two hour test and must the gauge return to 0 when the test is completed.
- E. Pressure test to be in strict conformance with AWWA C600, Section 4.1 and 4.2. Test for leakage in conformance with AWWA C600, Section 4.2 Table 6. Remedy all visible leaks and locate and repair leakage in lines which exceed the specified amounts.
- F. Contractor to coordinate with Owner for scheduling of test. Owner to be present during any testing.

4.2 CLEANING

- A. Cleaning and disinfection of all piping shall be in accordance with AWWA C-651 and all applicable CFPUA specifications, if discrepancies exist the more stringent shall apply.
- B. Clean and disinfect water distribution piping as follows:
 - 1. Purge new water distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
 - 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by that authority, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
 - 3. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine. Isolate system or part thereof and allow to stand for 24 hours. A residual of 10 ppm of chlorine shall be produced in all parts of the system at the end of the 24-hour period. All valves, hydrants and accessories shall be open and/or operated.
 - 4. Following allowed standing time, flush system with clean, potable water until chlorine does not remain above normal water levels in water coming from system.

5. Submit water samples in sterile bottles to the testing laboratory. Repeat procedure if biological examination shows evidence of contamination.
 - C. Prepare reports for purging and disinfecting activities.
 - D. Clean out the water distribution system and leave free from foreign materials or any sort prior to sterilization.
- 4.3 DISINFECTION
- A. Disinfection shall be per CFPUA standard specifications, Section 02660, "Water Distribution System".

END OF SECTION 33 11 16

SECTION 33 31 00 - SANITARY SEWER PIPING

PART 1 GENERAL

1.1 GENERAL NOTES

- A. All sanitary sewerage structures, related piping and accessories shall be in accordance with the State of North Carolina Department of Environment and Natural Resources standards, and supplemented with any applicable Cape Fear Public Utility Authority standards or specifications. If discrepancies exist they should be brought to the Engineer's attention immediately.
- B. Refer to construction drawings for number, location and details of all proposed structures and pipes.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Materials, Installation, and Testing shall be in accordance with NCDOT and Cape Fear Public Utility Authority standards and specifications.

1.3 SUMMARY

- A. This section includes gravity-flow, non-pressure sanitary sewerage outside of the building, which includes but is not limited to the following items and appurtenances, shown on drawings and specified in this Section:
 - 1. Piping.
 - 2. Fittings.
 - 3. Couplings.
 - 4. Manholes.
 - 5. Cleanouts.
- B. Related Sections: The following Sections contain requirements that relate to the Section:
 - 1. Division 31, Section "Trenching"
 - 2. Division 31, Section "Dewatering"

1.4 DEFINITIONS

- A. PVC: Polyvinyl Chloride Pipe.
- B. DIP: Ductile Iron Pipe.

- C. NCDENR: North Carolina Department of Environment and Natural Resources.
- D. CFPUA: Cape Fear Public Utility Authority.

1.5 SUBMITTALS

- A. Product Data: Manufacturer information describing part, accessories, connections and any standard details.
- B. Manufacturer's Instructions: Special procedures required to install specified products.
- C. Shop Drawings: Indicate Part Sizes, connection sizes, elevations and connection parts.
- D. Manufacturer's Certificate: Products meet or exceed specified requirements.
- E. Qualifications Statements:
 - 1. Qualifications for manufacturer, and installer.
 - 2. Manufacturer's approval of installer.
- F. Field quality-control reports.
- G. Project Record Documents: Record actual locations of cleanouts, joints with changes in direction and invert elevations.
- H. Operation and Maintenance Data: Submit any special requirements for maintenance.

1.6 QUALITY ASSURANCE

- A. Perform Work according to NCDENR and CFPUA standards and specifications.
- B. Fabricator: Company specializing in fabricating products specified in this Section with three years' experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store according to manufacturer's instructions.
- B. Protect any UV sensitive materials from sunlight by using manufacturer recommendations.
- C. Handle manholes according to manufacturer's written rigging instructions.

1.8 PROJECT CONDITIONS

- A. Interruption of Existing Sewer Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Owner's Representative no fewer than (72) hours in advance of proposed interruption of service.

2. Do not proceed with interruption of service without Owner's Representative's written permission.
- B. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 PVC PIPE AND FITTINGS

- A. Sewer mains and service laterals shall have a minimum of 3 feet of cover.
- B. Pipe sizes 4" to 6" shall be SCH 40 conforming to the requirements of ASTM D1785 with solvent weld joints conforming to ASTM D2672.
- C. Pipe sizes 8" through 12" shall be Class 150, DR18 conforming to the requirements of AWWA C900 with elastomeric push-on joints conforming to ASTM D3212 or ASTM D3139.
- D. Couplings shall be mechanical joint ductile iron.
- E. Fasteners shall be 316 stainless steel or better where exposed to sewer or sewer gases.

2.2 DIP AND FITTINGS

- A. Ductile Iron Pipe shall conform to ASTM A746, ANSI/AWWA C151/A21.51, Class 350, lined with Protecto 401 ceramic epoxy, "Sewpercoat" or approved equal unless otherwise shown or specified.
- B. Joints shall be rubber gasket push-on, conforming to ANSI/AWWA C111/A21.11, or mechanical joint conforming to ANSI/AWWA C110/A21.10 as modified by ANSI/AWWA C151/A21.51.
- C. Fittings and specials shall be suitable for 150 pounds per square inch pressure rating unless otherwise specified. Fittings and specials for mechanical joint pipe shall conform to ANSI/AWWA C110/A21.11 lined with Protecto 401 ceramic epoxy, "Sewpercoat" or approved equal unless otherwise shown or specified.

2.3 PIPE COUPLINGS

- A. Couplings between dissimilar pipe materials (PVC to ductile iron) shall be mechanical joint ductile iron only or adapter conforming to ASTM 3139 lined with Protecto 401 ceramic epoxy, "Sewpercoat" or approved equal. For pipes 8" and larger, manholes are also acceptable. Fernco flexible type couplings are NOT permitting.

2.4 MANHOLES

- A. Pipe to manhole connectors shall conform to ASTM C923. The location of the pipe connectors shall vary from the location shown on the project plans no more than ½ inch vertically and 5 degrees horizontally. Provide for control of the pipe OD to within the tolerances of the connector on flexible pipes larger than 12 inches.

- B. Manhole interiors that are required to be lined shall be in accordance with CFPUA standards and specifications.
- C. All in place penetrations into manholes must be by core boring methods including main line and service drops. Properly sized elastomeric boots shall be set in penetrations. The boot and the pipe must be fully mortared on the inside and the outside of the manhole.
- D. Inside drop for sewer mains and services shall conform to the detail with all material to be 316 stainless steel or better, excluding piping. Drop pipe Rev 1.04 02731.6 shall be anchored to the manhole as shown on the detail with intermediate supports on 30-inch spacing as required.
- E. Castings shall be in accordance with CFPUA standards and specifications.

2.5 CLEANOUTS

- A. Cleanout to be nominal 6" diameter by 12" cast-iron box and cover shall be furnished and installed flush with the final grade as per the standard detail shown on the construction drawings.
- B. "C.O." shall be stamped on the lid.
- C. The box shall conform to the standard detail.
- D. Any other required accessories for installation shall be engineer approved prior to installation.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that excavations, dimensions and elevations are as indicated.
- B. Check structures for cracks or other compromising features.
 - 1. Any irregularities shall be reported and approved prior to installation.

3.2 PREPARATION

- A. Correct over-excavation with coarse aggregate.
- B. Prepare base in accordance with applicable CFPUA standard.

3.3 INSTALLATION

- A. Installation Standards: Install Work according to CFPUA standards and manufacturer recommendations. If discrepancies exist they should be brought to Engineer's attention immediately.
- B. Pipe Installation

1. Install PVC pipe in strict accordance with ASTM D2321. Install manholes as indicated on the construction drawings. Install ductile iron pipe in accordance with AWWA C600.
2. Pipe shall be kept clean at all times, and no pipe shall be used in the work that does not conform to the appropriate ASTM Specifications. The laying of pipe in finished trenches shall commence at the lowest point, with the spigot ends pointing in the direction of flow. All pipe shall be laid with the ends abutting accurately to the lines and grades as shown on the plans, or as directed by the Owner. They shall be carefully centered so that when laid they will form a sewer with uniform invert.
3. Preparatory to making pipe joints, all surfaces of the portion of the pipe to be jointed or of the factory made jointing material shall be clean and dry. Lubricants, primers, adhesives, etc. shall be used as recommended by the pipe or joint manufacturer's specifications. The jointing material or factory fabricated joints shall then be placed, fitted, and adjusted in such workmanlike manner as to obtain the degrees of water tightness required. Trenches shall be kept dry during bedding, laying and jointing and for as long a period as required. As soon as possible after the joint is made, sufficient backfill material shall be placed along each side of the pipe to offset conditions that might tend to move the pipe offline and grade.
4. No superficial loads shall be placed on the exposed surface of the trench, unless the backfill is of non-cohesive material, is vibrated or tamped in layers not exceeding 6 inches in depth, until the Owner is satisfied that sufficient settlement has occurred to alleviate undue live or impact loads. Any defects due to settlement shall be corrected by the Contractor at no additional cost to Owner. Bell holes shall be dug sufficiently large to insure the making of proper joints. Water shall not be allowed to rise in the excavation until all the joint material has received its set. Great care shall be used to secure water tightness, and to prevent damage to or disturbing of the joints during the backfilling process or at any other time. Special precautions shall be exercised to prevent any pipe from resting on rock or any other hard projection which might cause breaking of the pipe. During construction, the mouth of the completed pipe shall always be kept properly closed with a suitable plug to prevent the entrance therein of any water, earth, stones or other debris. The Contractor shall also take any and all measures to keep the pipe clean and free from deposits and protect the pipe from damage.
5. Cleaning Pipe: The pipes shall be thoroughly cleaned before they are laid and shall be kept clean until acceptance of the completed work. The upper end of all pipe lines shall be provided with a header carefully fitted, so as to keep dirt and other substances from entering. This header shall be kept in the end of the pipe line at all times when laying is not in actual progress.
6. Service Connections: Sewer laterals shall be connected to the main by means of a wye fitting installed in the top quadrant of the pipe but shall not be installed straight up. Where it is necessary to lay new services or relay or tie in existing services the Contractor shall use the materials and type joints as shown on the plans, as given in the specifications, or as directed by Engineer.
 - a. Services shall be connected at manholes when noted on the drawings or when requested by Engineer. Connections shall be made by core boring

- manhole and field installation of the proper size elastomeric boot mortared inside and outside the manhole.
- b. Service lines that enter manholes shall enter on the shelf or at a minimum of crown to crown for the receiving pipe.
- 7. Contractor to provide a clean-out and stub solvent weld cap as shown in details. During installation, any services, utilities, pavement, concrete etc. damaged by the Contractor shall be properly maintained and repaired to match existing condition by the Contractor at his expense.
- 8. Clean-outs: Shall be located as per the standard detail. A 6-inch diameter cast box and cover shall be provided over clean-out plug. Clean-out box to be placed on 4 inches of stone.
 - a. Install cleanouts and riser extensions from sewer pipes to clean-outs at grade.
 - b. Use PVC fittings in sewer pipes at branches for cleanouts and PVC pipe for riser extensions to clean-outs.
 - c. Install piping so clean-outs open in direction of flow.
 - d. Use light-duty, top-loading classification clean-outs in earth or unpaved foot-traffic areas.
 - e. Use heavy-duty, top loading classification cleanouts in vehicle traffic service areas.
 - f. Clean-outs frames and covers located in earth shall be in cast-in-place concrete block, 18 inches by 18 inches by 12 inches deep. Set with top 1 inch above surrounding grade.
 - g. Clean-out frames and covers located in pavement shall be set with tops flush to finished pavement surface.
- 9. Pavements Replacements: Where it is necessary for the Contractor to cut, drop or otherwise remove pavement to install sewer lines, the Contractor shall replace pavement to match existing conditions.
- 10. Cutting of Pipe: Cut pipe in a neat manner without damage to the pipe or any fittings or specials.
- 11. Crossings: When sewer crosses water mains, it shall be laid to provide a minimum vertical separation of 18 inches between the bottom of the water main pipe and the top of the sewer pipe. The crossing shall be perpendicular so that the sewer joints will be equidistant and at least 10 feet from the crossing in each direction.

C. Manholes – *Not Used*

3.4 FIELD QUALITY CONTROL

- A. Request inspection by Engineer prior to back filling any aggregate.
- B. If inspections indicate that Work does not meet specified requirements, remove Work, replace and request additional inspections.
- C. Provide a signed and sealed as-built survey by a licensed Land Surveyor in North Carolina for all locations, lengths, sizes and inverts of all structures and piping. Land surveyor

should also indicate any and all underground utilities encountered during excavation, including elevations tied to local control.

3.5 TESTING

- A. General: The Contractor shall be responsible for providing all equipment necessary for tests of displacement, deflection, and leakage. Tests of deflection and leakage shall be performed by the Contractor and observed by Owner and/or Engineer.
- B. Test for Deflection: Deflection tests may be performed on all sections of flexible pipe.
 - a. Maximum allowable deflection shall be 5 percent at any point.
 - b. Deflection shall be measured with a pin-type mandrel "Go/No Go" gauge. The gauge shall be pulled through the pipe by means of a strong cord or cable.
 - c. Any section of pipe not meeting the 5 percent maximum deflection shall be excavated, backfilled, re-compacted and retested.
- C. Test for Leakage: All segments of completed line may be tested for leakage by low pressure air test, except that the infiltration test may be used as approved by Owner's representative.
 - a. The Contractor shall remedy all visible leaks in pipes, manholes and appurtenances.
 - b. Air Testing: Air testing shall be conducted in the presence of the Owner and conform to the following:
 - 1. Test pressure shall be 3.5 psi increased by the ground water pressure above the top of the sewer.
 - 2. Pressure loss from the 3.5 psi shall not exceed 0.5 psi during the required testing time.
 - 3. Testing time in minutes shall be calculated at $0.625 \times$ nominal pipe size (inches).
- D. Test results: Certified copies of all test results shall be furnished to the Owner and Engineer within 1 week of test.

END OF SECTION 33 31 00

SECTION 334100 - STORM UTILITY DRAINAGE PIPING

PART 1 GENERAL

1.1 GENERAL NOTES

- A. All storm drainage structures, related piping and accessories shall be in accordance with the State of North Carolina Department of Transportation standards, and supplemented with any applicable New Hanover County standards. If discrepancies exist they should be brought to the Engineer's attention immediately.
- B. Refer to construction drawings for number, location and details of all proposed structures and pipes.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Materials, Installation, and Testing shall be in accordance with NCDOT and New Hanover County standards and specifications.

1.3 SUMMARY

- A. Section includes but not limited to the following items and appurtenances shown on drawings and specified in this Section:
 - 1. Pipe and fittings.
 - 2. inlets and outlets.
- B. Related Sections: The following Sections contain requirements that relate to the Section:
 - 1. Division 31, Section "Earth Moving"
 - 2. Division 03, Section "Cast-In-Place Concrete"

1.4 DEFINITIONS

- A. RCP: Reinforced Concrete Pipe.
- B. NCDOT: North Carolina Department of Transportation.

1.5 SUBMITTALS

- A. Product Data: Manufacturer information describing part, accessories, connections and any standard details.
- B. Manufacturer's Instructions: Special procedures required to install specified products.
- C. Shop Drawings: Indicate Part Sizes, connection sizes, elevations and connection parts.
- D. Manufacturer's Certificate: Products meet or exceed specified requirements.
- E. Qualifications Statements:
 - 1. Qualifications for manufacturer, and installer.
 - 2. Manufacturer's approval of installer.

1.6 FIELD QUALITY-CONTROL REPORTS.

- F. Project Record Documents: Record actual locations of catch basins, drop inlets, yard inlets and grate/rim and invert elevations.
- G. Operation and Maintenance Data: Submit any special requirements for maintenance.

1.7 QUALITY ASSURANCE

- A. Perform Work according to State of North Carolina Department of Transportation and the New Hanover County standards.
- B. Fabricator: Company specializing in fabricating products specified in this Section with three years' experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect pipe, pipe fittings, and seals from dirt and damage.
- B. Store according to manufacturer's instructions.
- C. Protect any UV sensitive materials from sunlight by using manufacturer recommendations.

1.9 PROJECT CONDITIONS

- A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Owner's Representative no fewer than (72) hours in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of service without Owner's Representative's written permission
- B. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 CONCRETE PIPE AND FITTINGS

- A. Reinforced-Concrete Pipe and Fittings: ASTM C 76. Pipe and special fittings installed with 10 feet or less cover, but more than 2 feet of cover, over top of pipe shall be Class III, and all other pipe and special fittings shall be Class IV. Basis of acceptance of reinforced concrete pipe shall be the 0.01" crack.
 - 1. Bell-and-spigot ends and sealant joints with ASTM C 990, bitumen or butyl-rubber sealant.

2.2 PIPE OUTLETS

- A. Riprap Basins: Broken, irregularly sized and shaped, graded stone according to NSSGA's "Quarried Stone for Erosion and Sediment Control."
 - 1. Average Size: NSSGA No. R-3, screen opening 2 inches.
 - 2. Average Size: NSSGA No. R-4, screen opening 3 inches.
 - 3. Average Size: NSSGA No. R-5, screen opening 5 inches.

- B. Filter Stone: According to NSSGA's "Quarried Stone for Erosion and Sediment Control," No. FS-2, No. 4 screen opening, average-size graded stone.
- C. Energy Dissipaters: According to NSSGA's "Quarried Stone for Erosion and Sediment Control," No. A-1, 3-ton average weight armor stone, unless otherwise indicated.

PART 3 EXECUTION

3.1 EARTHWORK

- A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 EXAMINATION

- A. Verify that excavations, dimensions and elevations are as indicated.
- B. Check pipes for cracks or other compromising features.
 - 1. Any irregularities shall be reported and approved prior to installation.

3.3 PREPARATION

- A. Correct over-excavation with coarse aggregate.
- B. Prepare base in accordance with applicable NCDOT standard.

3.4 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
- C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
- F. Laser Equipment: Contractor shall utilize laser equipment to insure that piping is installed at elevations and slopes indicated on plans.
- G. Install gravity-flow, non-pressure drainage piping according to the following:
 - 1. Install piping pitched down in direction of flow.
 - 2. Install piping at invert elevations as specified in the storm drainage table.
 - 3. Install nonreinforced-concrete piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

4. Install reinforced-concrete piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

3.5 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, non-pressure drainage piping according to the following:
 1. Join PVC piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasketed joints.
 2. Join nonreinforced-concrete piping according to ASTM C 14 and ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.
 3. Join reinforced-concrete piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.

3.6 STORMWATER INLET AND OUTLET INSTALLATION

- A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.
- B. Construct riprap of broken stone, as indicated.
- C. Install outlets that spill onto grade, anchored with concrete, where indicated.
- D. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.
- E. Construct energy dissipaters at outlets, as indicated.

3.7 CONNECTIONS

- A. Make connections to existing piping and underground manholes.
 1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
 2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
 3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.
 - a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
 - b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
 4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material

that may accumulate.

3.8 IDENTIFICATION

- A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.
 - 1. Use identification tape or non-detectable warning tape over all underground lines outside building footprint in the backfill approximately 18" to 30" above the service pipe, but a minimum of 10" and a maximum of 24" below finished grade.
 - 2. Use detectable warning tape over ferrous and nonferrous piping and over edges of underground manholes. Tape all underground lines outside building footprint directly on top of the pipeline and permanently secured to the pipeline at 10' intervals.
 - 3. Use insulated copper tracer wire or other approved conductor installed adjacent to underground nonmetallic piping and metallic pipe with compression gasket fittings installed underground. Access shall be provided to the tracer wire or the tracer wire shall terminate aboveground at the end of the nonmetallic piping. The tracer wire size shall not be less than 10AWG and the insulation type suitable for direct burial. The tracer wire size shall be copper single-conductor 10AWG minimum and the insulation type suitable for direct burial with type "UF" (Underground Feeder) insulation and shall be continuous along the pipeline passing through the inside of each valve box or manhole.

3.9 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
 - 1. Submit separate reports for each system inspection.
 - 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. : Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 - 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 - 4. Reinspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 - 1. Do not enclose, cover, or put into service before inspection and approval.
 - 2. Test completed piping systems according to requirements of authorities having jurisdiction.
 - 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours'

advance notice.

4. Submit separate report for each test.
5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
 - a. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.
 - b. Option: Test plastic piping according to ASTM F 1417.
 - c. Option: Test concrete piping according to ASTM C 924. C. Leaks and loss in test pressure constitute defects that must be repaired.
 - d. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.10 CLEANING

- A. Clean interior of piping of dirt and superfluous materials. Flush with water.

END OF SECTION 334100

SECTION 334913 - STORM DRAINAGE STRUCTURES

PART 1 GENERAL

1.1 GENERAL NOTES

- A. All storm drainage structures, related piping and accessories shall be in accordance with the State of North Carolina Department of Transportation standards, and supplemented with any applicable New Hanover County standards. If discrepancies exist they should be brought to the Engineer's attention immediately.
- B. Refer to construction drawings for number, location and details of all proposed structures and pipes.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Materials, Installation, and Testing shall be in accordance with NCDOT and New Hanover County standards and specifications.

1.3 SUMMARY

- A. Section includes but not limited to the following items and appurtenances shown on drawings and specified in this Section:
 - 1. Catch Basins.
 - 2. Drop Inlets.
 - 3. Junction Boxes/Manholes.
 - 4. Headwalls.
 - 5. Accessories.
 - 6. Stormwater Structures.
 - 7. Concrete.
- B. Related Sections: The following Sections contain requirements that relate to the Section:
 - 1. Division 31, Section "Earth Moving"
 - 2. Division 03, Section "Cast-In-Place Concrete"

1.4 DEFINITIONS

- A. RCP: Reinforced Concrete Pipe
- B. NCDOT: North Carolina Department of Transportation.

1.5 SUBMITTALS

- A. Product Data: Manufacturer information describing part, accessories, connections and any standard details.
- B. Manufacturer's Instructions: Special procedures required to install specified products.

- C. Shop Drawings: Indicate Part Sizes, connection sizes, elevations and connection parts.
- D. Manufacturer's Certificate: Products meet or exceed specified requirements.
- E. Qualifications Statements:
 - 1. Qualifications for manufacturer, and installer.
 - 2. Manufacturer's approval of installer.
- F. Field quality-control reports.
- G. Project Record Documents: Record actual locations of catch basins, drop inlets, yard inlets and grate/rim and invert elevations.
- H. Operation and Maintenance Data: Submit any special requirements for maintenance.

1.6 QUALITY ASSURANCE

- A. Perform Work according to State of North Carolina Department of Transportation and the New Hanover County standards.
- B. Fabricator: Company specializing in fabricating products specified in this Section with three years' experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store according to manufacturer's instructions.
- B. Protect any UV sensitive materials from sunlight by using manufacturer recommendations.
- C. Handle manholes according to manufacturer's written rigging instructions.
- D. Handle catch basins, drop inlets, and headwalls according to manufacturer's written rigging instructions.

1.8 PROJECT CONDITIONS

- A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Owner's Representative no fewer than (72) hours in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of service without Owner's Representative's written permission.
- B. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 CATCH BASINS

- A. All catch basins to be precast in accordance with the NCDOT standard specifications.
- B. Catch Basins Lids and Frames:

1. Materials: Cast Iron
 2. Lid: Shall be in accordance with applicable NCDOT standard detail as noted.
 3. Nominal Lid and Frame Size: *Varies*, see signed construction drawings.
 - C. Connections
 1. All connections to be in accordance with the NCDOT standard specifications.
- 2.2 DROP INLETS
- A. All drop inlets to be precast in accordance with the NCDOT standard specifications.
 - B. Drop inlet Lids and Frames
 1. Materials: Cast Iron
 2. Lid: Shall be in accordance with applicable NCDOT standard specifications.
 3. Nominal Lid and Frame Size: *Varies*, see signed construction drawings.
 - C. Connections
 1. All connections to be in accordance with the NCDOT standard specifications.
- 2.3 JUNCTION BOXES/MANHOLES
- A. Materials
 1. Reinforced Concrete. To be precast in accordance with the applicable NCDOT standard specifications.
 - B. Connections
 1. Connections to be minimum soil-tight.
 2. All connections to be in accordance with NCDOT standard specifications.
 - C. Lids and Frames:
 1. Shall conform to NCDOT standard specifications.
- 2.4 HEADWALLS
- A. Materials
 1. Reinforced Concrete in accordance with North Carolina Railroad standards.
 - B. Connections
 1. Connections to be minimum soil-tight.
 2. All connections to be in accordance with Standard Specifications and New Hanover County Standards.
 3. In Bored and Jacked scenarios, casing and carrier pipe shall be restrained, as to prevent slipping or other movement.
 - C. Design
 1. Design of headwall to be completed by registered Professional Engineer licensed in North Carolina.
 2. Contractor to submit shop drawings to Engineer and Owner for approval. Engineer to only approve shop drawings on the basis of dimensions and size. Engineer not responsible for any footing, shoring or structural aspect of headwall.

2.5 ACCESSORIES

- A. Geotextile Fabric:
 - 1. Shall conform to AASHTO M288.
 - 2. Shall be Class 1, and non-biodegradable.
- B. Any other required accessories for installation shall be engineer approved prior to installation.

2.6 STORMWATER STRUCTURES

- A. Cast-in-Place Concrete, Stormwater Structures: Construct of reinforced-concrete bottom, walls, and top; according to ASTM C 890 structural loading; of depth, shape, dimensions, and appurtenances indicated.
 - 1. Anti-Floatation Block: Can either be cast-in-place or precast
 - a. If cast-in-place prior to constructing, the contractor shall insure the weight of the entire riser structures meets minimum specifications provided on Drawings, and shall submit shop drawings to the Engineer for review denoting the following:
 - 1) Steel reinforcement
 - 2) Connection mechanism to join anti-floatation block with riser section.
 - b. If precast, the anti-floatation block shall be included as part of the precast riser shop drawing submittals to the Engineer for review. It shall meet minimum specifications provided on Drawings.
 - 2. Concrete Collar: Shall connect to riser structure and anti-floatation block to form a watertight connection between outlet barrel and riser structure. It shall meet minimum specifications provided on Drawings.
- B. Steps: Provide steps as shown on the Drawings in manholes, risers, transition cones, and transition top sections in accordance with NCDOT STD 840.66. Steps shall be spaced at 16" O.C.
- C. Emergency drawdown pipe shall be a M&H style 1820 eccentric valve or approved equal. This valve is in accordance with AWWA C-540 Sec 5.5, and shall be operable from top of outlet structure via a handwheel. Refer to valve specifications at the end of this section.
- D. Trash rack: Prior to ordering, the contractor shall submit trash rack shop drawings to the Engineer for review. A minimum 2 foot x 3 foot access hatch opening is required and shall be centered over access steps. Trash rack shall meet minimum specifications provided on Drawings.
- E. Spillway Filter: Refer to installation procedures specified in Section 3.3.B.
 - 1. Stone to be fine aggregate, natural, or manufactured sand meeting the requirements of ASTM C33.
 - 2. Collector Pipe shall be smooth wall, schedule 80 PVC, 4-inch nominal diameter with minimum 0.25-inch diameter perforations.
 - 3. Cleanout and Outlet Pipes shall be smooth wall, schedule 80 PVC, 4-inch nominal diameter, solid.
 - 4. Provide elbows, connections, fittings, etc. for piping as required furnished by pipe manufacturer for type of pipe used.

- F. Energy Dissipaters: Refer to Drawings for shape and sizing; Design in accordance with NC Erosion and Sediment Control Planning and Design Manual.

2.7 CONCRETE

- A. General: Cast-in-place concrete according to ACI 318, ACI 350/350R, and the following:
 - 1. Cement: ASTM C 150, Type II.
 - 2. Fine Aggregate: ASTM C 33, sand.
 - 3. Coarse Aggregate: ASTM C 33, crushed gravel.
 - 4. Water: Potable.
- B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.
 - 1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
 - 2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.
- C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.
 - 1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
 - a. Invert Slope: 2 percent through manhole.
 - 2. Benches: Concrete, sloped to drain into channel.
 - a. Slope: 50 percent.
- D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.
 - 1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
 - 2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

PART 3 EXECUTION

3.1 EARTHWORK

- A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.1 EXAMINATION

- A. Verify that excavations, dimensions and elevations are as indicated.
- B. Check structures for cracks or other compromising features.
 - 1. Any irregularities shall be reported and approved prior to installation.

3.2 PREPARATION

- A. Correct over-excavation with coarse aggregate.

- B. Prepare base in accordance with applicable NCDOT standard.

3.3 INSTALLATION

- A. Installation Standards: Install Work according to NCDOT standards and manufacturer recommendations. If discrepancies exist they should be brought to Engineer's attention immediately.
- B. Spillway Filter Installation
 1. Provide trench width to allow installation of drainage conduit. Grade bottom of trench excavations to required slope, and compact to firm, solid bed for drainage system. Trench shall extend at least 2 feet below spillway pipe.
 2. Lay flat-style geotextile filter fabric in trench and overlap trench sides.
 3. Place supporting layer of drainage course (NCDOT #67 washed stone) as specified on Drawings.
 4. Install perforated piping as specified on Drawings for spillway filter subdrainage.
 5. Contractor shall provide a watertight seal between the filter fabric and principal spillway pipe.
 6. Add drainage course (NCDOT #67 stone) to top of drainage conduits. Spillway filter depth shall be in accordance with the depth specified in the Drawings. Cover drainage conduit as specified on Drawings.
 7. Completely overlap both sides of filter fabric above drainage course. Top of overlap shall correspond to seepage direction.
 8. Fill to Grade: Fill with satisfactory soil to finish grade. Fill above the filter fabric shall consist of well-compacted clayey soils to prevent down slope run-off from rainfall from entering the drain.
 9. Care shall be taken during the drain construction to keep the washed stone clean and free of soil contamination; otherwise, the effectiveness of the drain can be seriously jeopardized.

3.4 FIELD QUALITY CONTROL

- A. Request inspection by Engineer prior to back filling any aggregate.
- B. If inspections indicate that Work does not meet specified requirements, remove Work, replace and request additional inspections.
- C. Provide a signed and sealed as-built survey by a licensed Land Surveyor in North Carolina for all locations, lengths, sizes and inverts of all storm drainage structures and piping. Land surveyor should also indicate any and all underground utilities encountered during excavation, including elevations tied to local control.

3.5 CLEANING

- A. Clean interior of structures of dirt and superfluous materials. Flush with water.

END OF SECTION 334913