

PROJECT MANUAL



NCSU Textiles Complex – Flex Factory Renovations

SCO#: 23-26253-01A

NCSU#: 202220031

FACILITY ID: 700

Bid Documents

March 2025

Clearscapes Architecture + Art

Book 1 of 1



NC State University Design and Construction

NC State's Division 00 & 01 Requirements

March 2025



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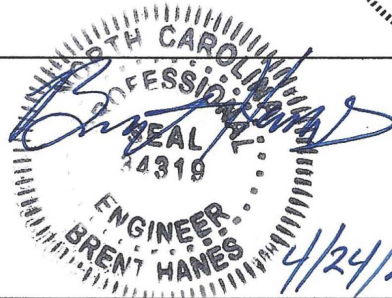
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FIRE PROTECTION ENGINEER

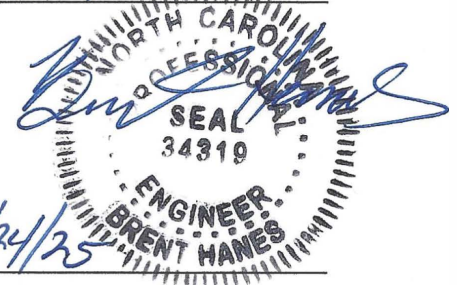
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4/24/25

PLUMBING ENGINEER

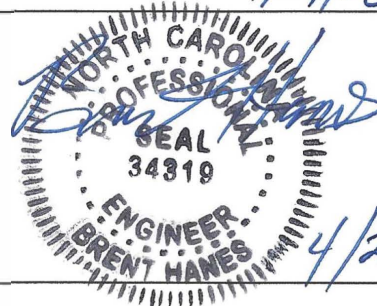
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GUIDELINES FOR RECRUITMENT AND SELECTION OF MINORITY BUSINESSES FOR PARTICIPATION IN STATE CONSTRUCTION CONTRACTS

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

SECTION A: INTENT

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

SECTION B: DEFINITIONS

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

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

SECTION C: RESPONSIBILITIES

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

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

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

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

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

2. State Construction Office

The State Construction Office will be responsible for the following:

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

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

3. Owner

Before awarding a contract, owner shall do the following:

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

4. Designer

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

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

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

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

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

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

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

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

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

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

6. Minority Business Responsibilities

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

SECTION 4: DISPUTE PROCEDURES

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

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

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

MINORITY BUSINESS CONTRACT PROVISIONS (CONSTRUCTION)

APPLICATION:

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

MINORITY BUSINESS SUBCONTRACT GOALS:

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

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

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

OR

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

OR

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

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

MINIMUM COMPLIANCE REQUIREMENTS:

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

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

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

APPENDIX E

MBE DOCUMENTATION FOR CONTRACT PAYMENTS

Prime Contractor/Architect: _____

Address & Phone: _____

Project Name: _____

Pay Application #: _____ Period: _____

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

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

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

Date: _____ Approved/Certified By: _____

Name

Title

Signature

SUBMIT WITH EACH PAY REQUEST & FINAL PAYMENT

DOCUMENT 003119 - EXISTING CONDITION INFORMATION

1.1 EXISTING CONDITION INFORMATION

- A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of the Bidders' own investigations. They are made available for Bidders' convenience and information, but are not a warranty of existing conditions. This Document and its attachments are not part of the Contract Documents.
- B. Existing drawings that include information on existing conditions including previous construction at Project site are available for viewing on Project Web site.
- C. Access to the existing building is available by arrangement with the Construction Manager.

END OF DOCUMENT 003119



FORM OF PROPOSAL

NCSU Textiles Complex – Flex Factory Renovations
North Carolina State University
SCO #23-23253-01A

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 regards to E-Verification as required by Section 2.(c) of Session Law 2013-418, codified as N.C. Gen. Stat. § 143-129(j).

The Bidder proposes and agrees if this proposal is accepted to contract with the State of North Carolina through North Carolina State University in the form of contract specified below, to furnish all necessary materials, equipment, machinery, tools, apparatus, means of transportation and labor necessary to complete the construction of the partial renovation of the Wilson College of Textiles, including interior demolition, new interior storefront, new interior finishes, new light fixtures and upgraded mechanical and electrical systems throughout the work area, in full in complete accordance with the plans, specifications and contract documents, to the full and entire satisfaction of the State of North Carolina, North Carolina State University, and Clearscapes with a definite understanding that no money will be allowed for extra work except as set forth in the General Conditions and the contract documents, for the sum of:

SINGLE PRIME CONTRACT:

Base Bid: _____

_____ Dollars(\$)

General Subcontractor:

_____ Lic _____

Plumbing Subcontractor:

_____ Lic _____

Mechanical Subcontractor:

_____ Lic _____

Electrical Subcontractor:

_____ Lic _____

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

ALTERNATES:

Should any of the alternates as described in the contract documents be accepted, the amount written below shall be the amount to be "added to" or "deducted from" the base bid. (Strike out "Add" or "Deduct" as appropriate.)



GENERAL CONTRACT:

Alternate No. G-01: Folding Glass Doors

(Add) _____ Dollars(\$)

Alternate No. G-02: Finishes

2A (Add) _____ Dollars(\$)

2B (Add) _____ Dollars(\$)

2C (Add) _____ Dollars(\$)

Alternate No. G-03: Secure Workspace Millwork

(Add) _____ Dollars(\$)

Alternate No. G-04: Electrified Door Hardware

(Add) _____ Dollars(\$)

Alternate No. G-05: Mechanical Door Hardware

(Add) _____ Dollars(\$)

HVAC CONTRACT:

Alternate No. H-01: HVAC Control

(Add) _____ Dollars(\$)

Alternate No. H-02: HVAC Control

(Add) _____ Dollars(\$)



UNIT PRICES:

Unit prices quoted and accepted shall apply throughout the life of the contract, except as otherwise specifically noted. Unit prices shall be applied, as appropriate, to compute the total value of changes in the base bid quantity of the work all in accordance with the contract documents.

GENERAL CONTRACT:

No. A1	<u>Trowelable Patching Compound</u>	<u>SF</u>	Unit Price (\$)	<u> </u>

FIRE PROTECTION CONTRACT:

No. FP1	<u>New sprinkler head</u>	<u>each</u>	Unit Price (\$)	<u> </u>

ELECTRICAL CONTRACT:

No. E1	<u>New photoelectric smoke detector</u>	<u>each</u>	Unit Price (\$)	<u> </u>

No. E2	<u>New emergency light</u>	<u>each</u>	Unit Price (\$)	<u> </u>

No. E3	<u>New exit sign</u>	<u>each</u>	Unit Price (\$)	<u> </u>

No. E4	<u>New Fire Alarm Horn/Strobe</u>	<u>each</u>	Unit Price (\$)	<u> </u>

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:

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 CONSTRUCTION CONTRACT

(ALL PRIME CONTRACTS)

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

hereinafter called the Party of the First Part and the State of North Carolina, through
the _____

_____ hereinafter called
the Party of the Second Part.

WITNESSETH:

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

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

Consisting of the following sheets:

Dated: _____ and the following addenda:

Addendum No. _____ Dated: _____ Addendum No. _____ Dated: _____

Addendum No. _____ Dated: _____ Addendum No. _____ Dated: _____

Addendum No. _____ Dated: _____ Addendum No. _____ Dated: _____

Addendum No. _____ Dated: _____ Addendum No. _____ Dated: _____

2. That the Party of the First Part shall commence work to be performed under this
agreement on a date to be specified in a written order of the Party of the Second Part and
shall fully complete all work hereunder within _____ consecutive calendar days
from said date. For each day in excess thereof, liquidated damages shall be as stated in

Supplementary General Conditions. The Party of the First Part, as one of the considerations for the awarding of this contract, shall furnish to the Party of the Second Part a construction schedule setting forth planned progress of the project broken down by the various divisions or part of the work and by calendar days as outlined in Article 14 of the General Conditions of the Contract.

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

(\$ _____).

Summary of Contract Award:

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

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

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

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

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

Witness:

Contractor: (Trade or Corporate Name)

(Proprietorship or Partnership)

By: _____

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

Attest: (Corporation)

By: _____

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

The State of North Carolina through*

(CORPORATE SEAL)

(Agency, Department or Institution)

Witness:

By: _____

Title: _____

FORM OF PERFORMANCE BOND

Date of Contract: _____

Date of Execution: _____

Name of Principal
(Contractor) _____

Name of Surety: _____

Name of Contracting
Body: _____

Amount of Bond: _____

Project _____

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

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

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

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

Executed in _____ counterparts.

Witness: _____

(Proprietorship or Partnership)

Attest: (Corporation)

By: _____

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

(Corporate Seal)

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 _____

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

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

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

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

Executed in _____ counterparts.

Witness:

(Proprietorship or Partnership)

Attest: (Corporation)

By: _____

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

(Corporate Seal)

Witness:

Countersigned:

(N.C. Licensed Resident Agent)

Name and Address-Surety Agency

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

Contractor: (Trade or Corporate Name)

By: _____

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

(Surety Company)

By: _____

Title: _____
(Attorney in Fact)

(Surety Corporate Seal)

Sheet for Attaching Power of Attorney

Sheet for Attaching Insurance Certificates

APPROVAL OF THE ATTORNEY GENERAL

**CERTIFICATION BY THE OFFICE OF STATE
BUDGET AND MANAGEMENT**

Provision for the payment of money to fall due and payable by the

under this agreement has been provided for by allocation made and is available for the purpose of carrying out this agreement.

This _____ day of _____ 20____.

Signed _____
Budget Officer

REQUEST FORM FOR ELECTRONIC FILES

Project Name: NCSU Textiles Complex – Flex Factory Renovations

Project Address: 1020 Main Campus Dr, Raleigh, NC 27606

In order to request Electronic Files from CLEARSCAPES, PA, this Request Form must be submitted to CLEARSCAPES, PA fully executed as indicated, and with no modifications. To avoid unnecessary time and expense in the preparation and transmittal of requested files, CLEARSCAPES, PA will respond to only one request, so all desired trades are to be indicated in the initial request. Subsequent requests for additional files or copies of the originally transmitted files will be denied. There are limitations to the type of file, when it will be made available, and to whom it will be made available. The Recipient named below agrees, without exception, to the following terms and conditions:

1. Recipient confirms its request to CLEARSCAPES, PA for electronic files listed below, which Recipient understands are to be provided only in accordance with, and conditioned upon, the terms and conditions of this Request Form.
2. CLEARSCAPES, PA agrees that Recipient may use the electronic files for the sole purpose of responding to Owner's request for information related to the Project. Any electronic files provided are strictly for the use of the Recipient in regard to the Project named above, and shall not be utilized for any other purpose or provided by the Recipient to any entity other than its subcontractors for the Project named above.
3. CLEARSCAPES, PA makes no representation or warranty of any kind, express or implied, with respect to the Electronic Files and specifically makes no warranty that the Electronic Files shall be merchantable or fit for any particular purpose, or accurate or complete. Furthermore, any description of said Electronic Files shall not be deemed to create an express warranty that such Electronic Files shall conform to said description.
4. Electronic Files are provided strictly as a courtesy by CLEARSCAPES, PA solely for the convenience of the Recipient, and are not part of the Bid Documents or Contract Documents for the Project. As stated herein, the possibility exists that the Electronic Files provided may differ from the Bid Documents or Contract Documents for construction of the Project. CLEARSCAPES, PA shall not be responsible for differences between Electronic Files, the Bid Documents, and Contract Documents. The Bid Documents or Contract Documents for the Project, may be modified by CLEARSCAPES, PA at any time, either before or after construction begins. CLEARSCAPES, PA has no responsibility, either before or after any such modification, to determine or to advise the Recipient whether any such modification causes Electronic Files provided to the Recipient to be out of date, inconsistent with the Bid Documents or Contract Documents, or otherwise unsuitable or unfit for use in any way.
5. The Recipient assumes all risk and liability for any losses, damages, claims, or expenses resulting from its receipt, use, or possession of Electronic Files furnished by CLEARSCAPES, PA.
6. The Recipient agrees to indemnify, defend and hold harmless CLEARSCAPES, PA, its officers, agents, employees, and Owner from and against any and all claims, suits, losses, damages or costs, including attorney's fees, arising from or by reason of the Recipient's use of Electronic Files provided by CLEARSCAPES, PA, and such defense and indemnification obligation duties shall survive any use under this Request Form.

7. All files provided by CLEARSCAPES, PA hereunder shall be in a format/version/layering determined solely by CLEARSCAPES, PA. The Recipient agrees that CLEARSCAPES, PA shall have no responsibility whatsoever for problems of any nature arising from the conversion of the files by the Recipient or others for use in non-native applications. CLEARSCAPES, PA will not provide files in compressed formats. Recipient agrees to accept the files in the format provided by CLEARSCAPES, PA, and that Recipient's conversion shall be at Recipient's sole risk.
8. Recipient acknowledges: (1) the files provided by CLEARSCAPES, PA are a graphical representation of the building in order to generate two-dimensional industry standard drawings; (2) the data may not be 100% accurate and should not be used for dimensional control, building layout, shop drawings, or any other similar purpose; (3) any schedule of materials produced directly from the files have not been checked for accuracy; and (4) the information in the files should be used only for comparative purposes and shall not be relied upon for accurate quantity estimates or used in establishing pricing.
9. CLEARSCAPES, PA, at its sole discretion, may modify the Electronic files before they are provided to the Recipient. Such modifications may include, but are not necessarily limited to, removal of certain information. CLEARSCAPES, PA, in its sole discretion, may refuse to provide some or all Electronic Files requested by Recipient.
10. The availability of Electronic Files that were not prepared by CLEARSCAPES, PA is subject to the consent of the Owner or consultant that prepared those Electronic Files. CLEARSCAPES, PA will not negotiate with the Owner or consultant or repeatedly solicit the Owner or consultant to obtain such consent. Neither this Request Form nor any such separate Consultant's consent may be assigned or transferred by Recipient to any other person or entity.
11. This Request Form contains all applicable terms and conditions relating to the provision of Electronic Files to the Recipient by CLEARSCAPES, PA. No other terms and conditions apply. This Request Form is not a part of the Bid Documents or Contract Documents for construction of the Project named above, and the terms and conditions defined herein are not subject to or superseded by any provisions of the Contract Documents for the Project, nor does this Request Form modify the Bid Documents or Contract Documents.
12. The Electronic Files provided to Recipient shall not be provided to others, except for those with direct contract with Recipient. The Electronic Files shall not be posted on any website, linked, or otherwise provided to any other person or entity. Recipient shall be responsible for any use by parties to whom the Recipient has provided the Electronic Files, including responsibility for the defense and indemnification obligation provided for in this Request Form. Recipient agrees it shall have no right to furnish or provide the Electronic Files in any litigation, administrative proceeding, arbitration or mediation except with the express written consent of Owner and CLEARSCAPES, PA.
13. The undersigned Recipient agrees to all of the above-stated terms and conditions without exception and hereby requests the listed Electronic Files for the Project named above

Name of entity or company (Recipient): _____

Name/Title of Authorized Recipient Representative: _____

Signature of authorized Recipient Representative: _____

Date: _____

Date:

Name:

Company:

Address: 1020 Main Campus Dr, Raleigh, NC 27606

Project: NCSU Textiles Complex – Flex Factory Renovations

Building Information Model(s) Release and Hold Harmless Agreement

CLEARSCAPES will grant access to the Building Information Model(s) (BIM) that has been created or will be created for **Project Name**, located at **Project Location**.

You hereby accept the BIM in its current condition. Any use which you make of the BIM and any action which you take based upon the information contained therein will be solely at your own risk, expense and liability. In consideration of CLEARSCAPES providing you with the BIM, you hereby waive and release any and all claims against CLEARSCAPES or any other party, including, but not limited to, any architect, engineer, consultant, or any other third party who contributed in any way to the preparation of the BIM, that may arise out of or relate in any way to the BIM, without regard to fault on the part of CLEARSCAPES. CLEARSCAPES makes no representation or warranty of any kind, express or implied, with respect to the BIM, including any and all amendments thereto or information contained therein. If the BIM varies from the design documents, for whatever or any reason, the design documents will supersede as the contractual documents and will define the original design intent. CLEARSCAPES and any other third party, such as an architect, engineer, or consultant, will not be liable for any direct, indirect, consequential, special or any other damages resulting from your use of the BIM, and you hereby release all claims and agree to hold said parties harmless from any and all such damages, costs and liabilities which you may incur. The BIM is provided solely and exclusively for use in completion of the Project. You shall indemnify and hold harmless CLEARSCAPES and any other third party, such as an architect, engineer, or consultant who contributed in preparation of the BIM for any use by you of the BIM outside the scope of the Project.

The BIM is provided for reference only and does not relieve you from the obligation to produce your own coordination models and/or shop drawings.

You will maintain sufficient controls on the BIM to ensure the security, integrity and copyrights of these files. You shall further ensure that the waivers, releases, and obligations identified in this agreement will be included in any contracts you issue to all parties retained on this project. You shall be liable for any damages arising from a breach of the terms of this agreement by your vendors or subcontractors.

You hereby acknowledge that you have voluntarily executed this Release and Hold Harmless Agreement and further warrant and represent that you understand the legal ramifications of having executed it, especially as it relates to the release and hold harmless provisions as set forth above.

This agreement shall be binding upon and inure to the benefit of the parties hereto, their successors, assigns and legal representatives. The agreement will be governed by the laws of the State of North Carolina without giving effect to its conflict of law principles. If any part of this agreement is found to be void or unenforceable, the remaining portions remain in full force and effect.

Name / Title

Date

SECTION 006000 – PROJECT FORMS

PART 1 – GENERAL

1.1. GENERAL

- A. Working copies of most Administrative Forms can be provided to Contractor by Owner or Designer upon request.
- B. Related Sections:
 - 1. All HUB Forms for the project can be found in Section 002126 "UNC System MB Guidelines & Forms 2024".

1.2. FORM OF AGREEMENT AND GENERAL CONDITIONS

- A. The following form of Owner / Contractor Agreement and form of the General Conditions shall be used for Project:
 - 1. Form of Construction Contract as shown in Section 005200 "Form of Construction Contract."
 - 2. The General Conditions for Project are specified in Section 007200 "General Conditions of the Contract."
 - 3. Supplementary General Conditions are specified in Section 007300 "Supplementary General Conditions."

1.3. ADMINISTRATIVE FORMS

- A. Copies of AIA standard forms may be obtained from the American Institute of Architects.
- B. Copies of CSI standard forms may be obtained from the Construction Standards Institute.
- C. Preconstruction Forms:
 - 1. Notice to Proceed.
 - 2. Designer Waste Information Form
- D. INFORMATION & MODIFICATION FORMS: Attached at the end of this Section.
 - 1. Subcontractor & Major Material Suppliers List.
 - 2. Requests for Interpretation (RFI).
 - 3. RFI Log.
 - 4. Submittal Transmittal.
 - 5. Substitution Request.
 - 6. Potential Change Order Form.
 - 7. HUB Change Order Form
 - 8. Field Order
 - 9. Punch List.
 - 10. Request for Designers Pre-Final Inspection Checklist
 - 11. Request for Final Inspection Checklist
 - 12. SCO Beneficial Occupancy Form

13. Final Acceptance Checklist
14. Project Closeout Checklist
15. Bulletin Form or ASI

E. PAYMENT FORMS:

1. Payment Application: AIA Document G702/703, "Application and Certificate for Payment and Continuation Sheet."
2. Sales Tax.
3. Stored Material Summary.

F. OPERATIONS FORMS

1. Method of Procedure Form.
2. Preconstruction Conference Agenda.
3. Designer Monthly Meeting Agenda.
4. Contractor Weekly Meeting Agenda.
5. Crane Lift Plan.
6. C&D Waste and Recycling Tracking Form.
7. Construction & Demolition Salvaged Material Form.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 006000

Designer Waste Information Form

Project Name: NCSU Textiles Complex – Flex Factory Renovations

Project Designer: Clearscapes, PA

Date: December 23, 2024

This form is to be completed by the designer and included with SD documents. Waste Management Plan will be based off of this form.

Waste Type (Condition of waste can determine category. Damaged Universal Waste can become Hazardous Waste)	Present at Site (Y/N)	Comments
Hazardous Waste and Material		
Asbestos	N	
Chemical Waste (liquid and solid)	N	
Lead Containing Paint/ Lead Based Paint Chips/ Lead Debris	N	
PCB containing items (ballasts, caulk, etc.)	Y	
Mercury contaminated debris/ piping/ P-traps	N	
Broken fluorescent lamps	N	
Universal Waste		
Mercury containing items (batteries, switches, etc.)	Y	
Batteries (all types)	N	
Fluorescent Lamps - Intact	Y	
Non-Regulated Waste		
Drywall	Y	
Insulation	Y	
Broad loom carpet	N	
Vinyl composition tile	Y	
Acoustic ceiling tile	Y	
Treated wood and MDF	Y	
Other Regulated Waste		
Refrigeration equipment	N	
Tires	N	
Recyclable		
White goods (lab refrigerators to be disposed of)	N	
Roofing materials (asphalt, shingles, gravel, metal) non-ACM or lead	N	
Oil	N	
Metal (fixtures, piping, ductwork, studs, wiring)	Y	
Cardboard	N	
Untreated wood	Y	
Aggregate, concrete, brick, asphalt	Y	
Carpet tile	N	
Non-PCB ballasts	N	

Email completed form to EH&S Hazardous Waste Program Manager (mdlong3@ncsu.edu) and Waste Diversion Coordinator, ajbensle@ncsu.edu

[illegible]

Email completed form to EH&S Hazardous Waste Program Manager (mdlong3@ncsu.edu) and Waste Diversion Coordinator, aibensle@ncsu.edu

SUBCONTRACTORS AND MAJOR MATERIAL SUPPLIERS LIST



PROJECT: _____ FROM (CONTRACTOR): _____

DATE: _____
TO (A/E): _____ A/E PROJECT NUMBER: _____

CONTRACT FOR: _____

LIST SUBCONTRACTORS AND MAJOR MATERIAL SUPPLIERS PROPOSED FOR USE ON THIS PROJECT AS REQUIRED BY THE CONSTRUCTION DOCUMENTS.
ATTACH SUPPLEMENTAL SHEETS IF NECESSARY.

NUMBER SECTION	SECTION TITLE	FIRM	ADDRESS	PHONE NUMBER	CONTACT

☐ Attachments

SIGNED BY: _____ DATE: _____

COPIES: ☐ Owner ☐ Consultants ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ File

REQUEST FOR INFORMATION



PROJECT: _____ R.F.I. NUMBER: _____

FROM: _____
TO: _____ DATE: _____

A/E PROJECT NUMBER: _____
RE: _____ CONTRACT FOR: _____

This Clarification Notice is issued for the purpose of clarifying the Contract Documents based on an interpretation reasonably inferable from the Contract Documents, and therefore has no effect on the Contract Sum or Contract Time. Proceeding with Work in accordance with this Clarification Notice indicates acceptance with no change in the Contract Sum or Contract Time.

SPECIFICATION SECTION:	PARAGRAPH:	DRAWING REFERENCE:	DETAIL:

REQUEST:

SIGNED BY:

DATE:

RESPONSE:

☐ Attachments

RESPONSE FROM:	TO:	DATE REC'D:	DATE RET'D:

SIGNED BY:	DATE:

COPIES: ☐ Owner ☐ Consultants ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ File

OWNER: _____ **CONTRACTOR:** _____

[illegible]

**SUBSTITUTION REQUEST FORM**

Project Name: _____
NC State Project Number: _____
SCO Project Number: _____

Substitution Request Number: _____

SPECIFICATION TITLE: _____

DESCRIPTION: _____

Section: _____ **Page:** _____

Article/Paragraph: _____

PROPOSED SUBSTITUTION: _____

MANUFACTURER: _____

ADDRESS: _____

PHONE: _____

TRADE NAME: _____

MODEL NO.: _____

INSTALLER: _____

ADDRESS: _____

PHONE: _____

HISTORY
:

☐ New Products

☐ 1-4 years old

☐ 5-10
years
old

☐ Over
10
years
old

DIFFERENCES BETWEEN PROPOSED SUBSTITUTION AND SPECIFIED PRODUCT:

☐ Point-by-point comparison data attached

REASON FOR NOT PROVIDING SPECIFIED ITEM:

SIMILAR INSTALLATION

PROJECT: _____
ADDRESS: _____

ARCHITECT:

OWNER:

WILL PROPOSED SUBSTITUTION AFFECTS OTHER PARTS OF WORK?
please explain.

Yes or No

If yes,



Project Name: _____
NC State Project Number: _____ Substitution Request Number: _____
SCO Project Number: _____

SAVINGS TO OWNER FOR ACCEPTING SUBSTITUTION: _____

WILL PROPOSED SUBSTITUTION CHANGE CONTRACT TIME? Yes or No If yes, please explain.

Supporting data attached ☐ Drawings ☐ Product Data

☐ Samples ☐ Tests ☐ Reports ☐ _____

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by: _____
Signature: _____
Firm: _____
Address: _____
Contact number: _____

A/E's REVIEW AND RECOMMENDATION

- ☐ Approve substitution – Make submittals in accordance with Specification Section 01-33-00 Submittal Procedures
- ☐ Approve substitution as noted – Make submittals in accordance with Specification Section 01-33-00 Submittal Procedures
- ☐ Reject substitution – Use specified materials
- ☐ Substitution Request received too late – Use specified materials



Project Name:	
NC State Project Number:	
SCO Project Number:	Substitution Request Number: _____

Signed by:	Date:

OWNER'S REVIEW AND ACTION

- ☐ Substitution approved – Make submittals in accordance with Specification Section 01-33-00 Submittal Procedures. Prepare change order.
- ☐ Substitution approved as noted - Make submittals in accordance with Specification Section 01-33-00 Submittal Procedures. Prepare change order.
- ☐ Substitution rejected – Use specified materials

Signed by:	Date:

Additional Comments Attached	

☐ Contractor	☐ Subcontractor	☐ Supplier	☐ Manufacturer	☐ A/E

Change Order Request #		
Contractor's Change Order Request Summary (Sheet "A")		
Item:	Code:	N.C.S.U. Project #
(Project Name)		
Company name Street Address City, State Zip		
(Line 17.) on sheet "B"	C.O.R. Request Total*	\$ -
* <u>Do Not</u> Round Off Numbers		
Signature: _____ Date: _____		
Print Name: _____		

|

|

|

|

Contractor Summary - (Sheet "B")			
		C.O.R. #	
		Project Name NCSU Project # SCO # Code: Item:	
Summary of Contractor's Self Performed Work			
(1.) (= line e. from Sheet "C").	Total Material*	\$	-
(2.) (=Line e. from Sheet "D").	Total Labor*	\$	-
(3.) (= line e. from Sheet "E").	Total Equipment*	\$	-
(4.) (=lines 1 + 2 + 3)	Total of Self Performed Work*	\$	-
Summary of Quoted Work (subcontractors)			
(5.)	Quote - Subcontractor #1 (company name)	Quote #1 Total* (without General Contractor OH&P)	\$ -
(6.)	Quote - Subcontractor #2 (company name)	Quote #2 Total* (without General Contractor OH&P)	\$ -
(7.)	Quote - Subcontractor #3 (company name)	Quote #3 Total* (without General Contractor OH&P)	\$ -
(8.)	Quote - Subcontractor #4 (company name)	Quote #4 Total* (without General Contractor OH&P)	\$ -
(9.) (lines 5 + 6 + 7 + 8)	Subtotal - Quoted (subcontract) Work* (w/o Gen Contractor OH&P)		\$ -
(10.) (on line 9.)	5% max (or as negotiated)	%OH&P	\$ -
(11.) (lines 9 + 10)	Total Quoted (subcontractor) Work (with Gen Contractor OH&P)		\$ -
(13.) (lines 4 + 11)	Total All Work* (without bond and ins)		\$ -
(14.) (on line 13.)		%Bond*	\$ -
(15.) (on line 13)		% Ins.*	\$ -
(16.) (lines 14 + 15)	Bonds & Insurance*		\$ -
(17.) (lines 13 + 16)	Grand Total All Work*		\$ -
* Do Not Round Off Numbers			

Material Break Down - (Sheet "C")

Material Description	Quantity	Unit	Price	Unit	Extension*
		ea.	@	\$ -	/ ea. = \$ -
		ea.	@	\$ -	/ ea. = \$ -
		ea.	@	\$ -	/ ea. = \$ -
		ea.	@	\$ -	/ ea. = \$ -
		ea.	@	\$ -	/ ea. = \$ -
		ea.	@	\$ -	/ ea. = \$ -
		ea.	@	\$ -	/ ea. = \$ -
		ea.	@	\$ -	/ ea. = \$ -
		ea.	@	\$ -	/ ea. = \$ -
		ea.	@	\$ -	/ ea. = \$ -
		ea.	@	\$ -	/ ea. = \$ -
		lin. feet	@	\$ -	/ lin. foot = \$ -
		lin. feet	@	\$ -	/ lin. foot = \$ -
		lin. feet	@	\$ -	/ lin. foot = \$ -
		lin. feet	@	\$ -	/ lin. foot = \$ -
		lin. feet	@	\$ -	/ lin. foot = \$ -
		lin. feet	@	\$ -	/ lin. foot = \$ -
		lin. feet	@	\$ -	/ lin. foot = \$ -
		sq. yds	@	\$ -	/ sq. yd = \$ -
		sq. yds	@	\$ -	/ sq. yd = \$ -
		sq. yds	@	\$ -	/ sq. yd = \$ -
		sq. yds	@	\$ -	/ sq. yd = \$ -
		cu. yds.	@	\$ -	/ cu. yd. = \$ -
		cu. yds.	@	\$ -	/ cu. yd. = \$ -
		cu. yds.	@	\$ -	/ cu. yd. = \$ -
		tons	@	\$ -	/ ton = \$ -
		tons	@	\$ -	/ ton = \$ -
		gals	@	\$ -	/ gal = \$ -
		gals	@	\$ -	/ gal = \$ -
		gals	@	\$ -	/ gal = \$ -
		gals	@	\$ -	/ gal = \$ -
		gals	@	\$ -	/ gal = \$ -
a. Total Materials*				\$	-
(on line a.)		b.	%	Sales Tax	\$ -
(lines a. + b.)		c.		Subtotal*	\$ -
(on line c.) - max 10% (or as negotiated)		d.	%	O.H.&P.	\$ -
(lines c. + d.)		e. Total Material*		\$	-

* **Do Not** Round Off Numbers

Labor Break Down (Sheet "D")

Labor Description	Time	Unit	Cost	Unit	Extension*
Foreman	/hr	@	\$ -	/hr	= \$ -
Tradesman	/hr	@	\$ -	/hr	= \$ -
Tradesman	/hr	@	\$ -	/hr	= \$ -
Tradesman	/hr	@	\$ -	/hr	= \$ -
Tradesman	/hr	@	\$ -	/hr	= \$ -
Tradesman	/hr	@	\$ -	/hr	= \$ -
Journey Man	/hr	@	\$ -	/hr	= \$ -
Journey Man	/hr	@	\$ -	/hr	= \$ -
Journey Man	/hr	@	\$ -	/hr	= \$ -
Journey Man	/hr	@	\$ -	/hr	= \$ -
Journey Man	/hr	@	\$ -	/hr	= \$ -
Laborer	/hr	@	\$ -	/hr	= \$ -
Laborer	/hr	@	\$ -	/hr	= \$ -
Laborer	/hr	@	\$ -	/hr	= \$ -
Laborer	/hr	@	\$ -	/hr	= \$ -
Apprentice	/hr	@	\$ -	/hr	= \$ -
Apprentice	/hr	@	\$ -	/hr	= \$ -
Apprentice	/hr	@	\$ -	/hr	= \$ -
Apprentice	/hr	@	\$ -	/hr	= \$ -
(a.) Subtotal Labor*					\$ -
(on Line a.) max 30%	(b.)	%	Burden	\$	-
(lines a. + b.)	(c.)		Subtotal*	\$	-
(on Line c.) max 10% (or as negotiated)	(d.)	%	O.H.&P.	\$	-
(lines c. + d.)	(e.)		Total Labor	\$	-

* Do Not Round Off Numbers

Equipment Break Down (Sheet "E")

Equipment Type	Rental Per Hour			Rental Per Day			Rental Per Week			Extension*	
	# Hour(s)		Charge	# Day(s)		Charge	# Week(s)		Charge		
	hr(s)	@	\$ - /hr	day(s)	@	\$ - /day	wk(s)	@	\$ - /wk(s)	\$ -	
	hr(s)	@	\$ - /hr	day(s)	@	\$ - /day	wk(s)	@	\$ - /wk(s)	\$ -	
	hr(s)	@	\$ - /hr	day(s)	@	\$ - /day	wk(s)	@	\$ - /wk(s)	\$ -	
	hr(s)	@	\$ - /hr	day(s)	@	\$ - /day	wk(s)	@	\$ - /wk(s)	\$ -	
	hr(s)	@	\$ - /hr	day(s)	@	\$ - /day	wk(s)	@	\$ - /wk(s)	\$ -	
	hr(s)	@	\$ - /hr	day(s)	@	\$ - /day	wk(s)	@	\$ - /wk(s)	\$ -	
	hr(s)	@	\$ - /hr	day(s)	@	\$ - /day	wk(s)	@	\$ - /wk(s)	\$ -	
	hr(s)	@	\$ - /hr	day(s)	@	\$ - /day	wk(s)	@	\$ - /wk(s)	\$ -	
a. Subtotal Equipment*										\$ -	
b. % Sales Tax											\$ -
c. Subtotal*										\$ -	
d. % O.H.&P.											\$ -
e. Total Equipment*										\$ -	

(No sales tax charge on contractor owned equipment)

(on line a.)

maximun 10% (or as negotiated)

(on Line c.)

(lines a. + b.)

(lines c. + d.)

* **Do Not** Round Off Numbers

Change Order Minority Participation

Code /Item:	Code: XXXXX Item:XXX
NCSU Project #:	072044
Contractor:	XXXXXXXXXXXXXX
C.O. Number	G-X
C.O. Scope of Work:	XXXXXXXXXXXXXX
C.O. Cost:	

HUB Subcontractor	Minority Category ¹	Contractor Trade ²	C.O. Dollar Value	Revised Contract Total
	N/A	N/A	N/A	N/A

¹ Black, African American (B), Hispanic (H), Asian American (A), American Indian (I), Female (F), Economically& Socially Disadvantaged (D)

² Contractor Trade - Select number (i.e. "2" for General - Demolition)

Contractor Trades			
1. Div 1 – General Contractor	55. Div 6 – Wood & Plastics – Architectural Woodwork	5. Div 10 – Specialties – Fire Extinguishers and Cabinets	24. Div 15A – Plumbing – Pipe & Pipe Fittings
2. Div 1 – General – Demolition	56. Div 6 – Wood & Plastics – Carpentry	6. Div 10 – Specialties – Identification Devices (Signage, etc.)	25. Div 15A – Plumbing – Pipe Insulation
3. Div 1 – General – Cleaning	57. Div 7 – Thermal/Moisture Protection – Building Insulation	7. Div 10 – Specialties – Toilet Accessories	26. Div 15B – Mechanical – Controls Work
4. Div 1 – General – Temp Facilities (fencing, trailers, etc)	58. Div 7 – Thermal/Moisture Protection – Fireproofing	8. Div 10 – Specialties – Toilet Partitions	27. Div 15B – Mechanical – Ductwork
40. Div 2 – Site Work – Grading	59. Div 7 – Thermal/Moisture Protection – Joint Sealing/Caulking	9. Div 11 – Equipment – Audio-visual (Projectors, Screens, etc.)	28. Div 15B – Mechanical – Mechanical Equipment
41. Div 2 – Site Work – Hauling	60. Div 7 – Thermal/Moisture Protection – Roofing	10. Div 11 – Equipment – Food Service	29. Div 15B – Mechanical – Pipe Duct Insulation
42. Div 2 – Site Work – Landscaping (seeding, planting, etc.)	61. Div 7 – Thermal/Moisture Protection – Waterproofing	11. Div 11 – Equipment – Residential	30. Div 15B – Mechanical – Pipe & Pipe Fittings
43. Div 2 – Site Work – Paving	62. Div 8 – Doors/Windows – Doors	12. Div 12 – Furnishings – Floor Mats	31. Div 15B – Mechanical/HVAC General
44. Div 2 – Site Work – Soil/Sediment Erosion & Control	63. Div 8 – Doors/Windows – Finish Hardware	13. Div 12 – Furnishings – Systems Furniture	32. Div 16 – Electrical – High/Medium Voltage (Transformers, Switches, etc.)
45. Div 2 – Site Work – Water/Sewer System	64. Div 8 – Doors/Windows – Glass & Glazing	14. Div 12 – Furnishings – Window Treatments	33. Div 16 – Electrical – Conduit
46. Div 3 – Concrete – Plain Concrete (sidewalks, curb & gutter, etc.)	65. Div 8 – Doors/Windows – Windows	15. Div 13 – Special Construction – Fire Protection (Sprinklers, etc.)	34. Div 16 – Electrical – Fire Alarm & Smoke Detection Systems
47. Div 3 – Concrete – Pre-cast Concrete	66. Div 9 – Finishes – Acoustic Panel Ceilings	16. Div 13 – Special Construction – Hazardous Materials Abatement	35. Div 16 – Electrical – General
48. Div 3 – Concrete – Structural Concrete	67. Div 9 – Finishes – Carpet	17. Div 13 – Special Construction – Security Systems	36. Div 16 – Electrical – Lighting Fixtures
49. Div 4 – Masonry – General	68. Div 9 – Finishes – Gypsum Drywall	18. Div 14 – Conveying Systems – Elevators	37. Div 16 – Electrical – Site Lighting
50. Div 4 – Masonry – Labor Only	69. Div 9 – Finishes – Hard Flooring (tiles, slate, etc.)	19. Div 14 – Conveying Systems – Escalators	38. Div 16 – Electrical – Telecommunications Systems
51. Div 5 – Metals – Architectural Metal (railings, etc.)	70. Div 9 – Finishes – Painting/Wallcoverings	20. Div 15A – Plumbing – Exterior Work	39. Div 16 – Electrical – Wiring & Wiring Devices
52. Div 5 – Metals – Light Gauge Metal (decking, etc.)	71. Div 9 – Finishes – Plaster	21. Div 15A – Plumbing – Fixtures	
53. Div 5 – Metals – Structural Steel	72. Div 9 – Finishes – Soft tile Flooring	22. Div 15A – Plumbing – Fuel Gas Piping & Equipment	
54. Div 5 – Metals – Structural Steel Erection	73. Div 9 – Finishes – Wood Flooring	23. Div 15A – Plumbing – General	

State Construction Office

Field Order # _____

Project: _____

Location: _____

Project ID: _____

Description of Change: _____

Justification of Change: _____

CONTRACTOR:

A total cost change not to exceed a lump sum cost is \$ _____ or a unit cost of _____ extended using estimated quantities to not exceed is \$ _____. The contractor will need a maximum number of _____ days time extension to the contract. The actual cost, not to exceed stated cost, shall be based on a realistic estimate based on current acceptable market values submitted with change order for approval by designer, owner, and State Construction Office.

DESIGNER:

The quoted price and need for the change are in the best interests of the owner to have the work accomplished. A formal change order will be prepared for contractor's signature within seven (7) days.

OWNING AGENCY:

The owning agency agrees to the change as being in the owner's best interest. Adequate funds are available to pay the cost for the change.

STATE CONSTRUCTION OFFICE:

The State Construction Office approves the request for the change.

SIGNATURES:

Contractor: _____

Date: _____

Designer: _____

Date: _____

Owning Agency: _____

Date: _____

State Construction Office: _____

Date: _____



Request for Designers Pre-Final Inspection Checklist

Project Name: _____

NC State Project Number: _____

NC State Code / Item: _____

SCO Project Number: _____

All items must be complete and verified by the Designer. Once items are verified as complete, Designer shall note the date complete and initial the line. If items are not applicable to the project, Designer shall note "N/A" in the date line.

Item	Date	Initials
Contractors Statement of Completion with Request for Designers Inspection, include Contractors Completion List		
Initial Submission of the TAB Report		
Pre-Functional Testing Report		
Operation & Maintenance Submittal Log showing all required O&M's have been approved		
Schedule of Owner Trainings		
Certification all Fire Extinguishers have been installed or delivered to N.C. State		
Demonstration of the operation of fire pumps to the N.C. State Fire Marshall		
Final Clean is Complete		
Laboratory Hood Certification by Contractors 3rd Party Inspector (if applicable)		
Roof & Window Water Test Reports (if applicable)		

Designers Approval: _____
Name Signature Date



Request for Final Inspection Checklist

Project Name: _____

NC State Project Number: _____

NC State Code / Item: _____

SCO Project Number: _____

All items must be complete and verified by the Designer. Once items are verified as complete, Designer shall note the date complete and initial the line. If items are not applicable to the project, Designer shall note "N/A" in the date line.

_____ (Designer of Record) provides information to the Owner and the State Construction Office that the project has been evaluated and field inspected to assure Life Safety Construction involving Fire Protection Systems (Fire Alarm, Sprinkler, etc.), egress, fire rated walls, and egress travel distances are constructed in accordance with the Contract Documents for Final Inspection to allow occupancy by the Owner.

Designer's Representative

Item	Date	Initials
Contractors Statement of Completion with Request for Designers Inspection, include Contractors Completion List		
Designer's Pre-Final Punch List Inspection		
SCO Final Inspection Scheduled for _____		
SCO Electrical Inspection (Certificate of Electrical Completion)		
Installer's Fire Alarm System Record of Completion (Certification) as required by NFPA 72		
Installers Sprinkler System Material & Test Reports:		
NFPA 13 (Sprinkler Systems)		
NFPA 14 (Standpipe & Hose Systems)		
NFPA 20 (Centrifugal Fire Pumps)		
NFPA 22 (Water Tanks for Private Fire Protection)		
NFPA 24 (Private Fire Service Mains)		
SCO Approval Letter for Sprinkler System		
Engineer's Approval of Battery Powered Emergency Devices		
Engineer's Approval Emergency and Standby Generator NFPA 110 Tests		
Engineer's Approval Electrical Service Ground Test Report		
Department of Labor Approval for Elevator		
Department of Labor Approval for Boiler & Pressure Vessels		
Department of Agriculture Approval for Fuel Tanks		



Item	Date	Initials
Health Department Inspection and Acceptance for Use		
Domestic Water Test Report and Acceptance for Use		
Laboratory Hood Certification by Contractors 3 rd Party Inspector		
Laboratory Hood Certification by N.C. State EH&S		
Engineers Approval of Test & Balance Report		
Engineers Verification Letter of Fire Damper Operation		
Backflow Preventer Certification		
Designers Approval of Stair / Ramp Survey		
Metal Building Manufacturer's Warranty		
Roofing Manufacturer's Warranty		
Commissioning Agents Approval		
Lightning Protection UL Master Label		
Special Inspectors Final Report / Resolutions		
Designer's Approval of Site Survey		

Designers Approval: _____
Name Signature Date

NCSU Approval: _____
Name Signature Date



North Carolina
State Construction Office

PROJECT APPROVAL AUTHORIZATION
PARTIAL UTILIZATION: (BENEFICIAL OCCUPANCY)

Project: _____

SCO Identification Number: _____ Contract Completion Date: _____

Project Owning Agency: _____

Owning Agency's Requester: _____ Date: _____

Designer's Statement:

_____ (Designer's Firm Name) provides information to the owner and the State Construction Office that the project has been evaluated and field inspected to assure that construction meets contract requirements for partial utilization and/or occupancy by the owning agency.

Designer's Representative Name

Project Description: _____

Project Partial Utilization Description: _____

BACK-UP DATA:
CONTRACTOR'S APPROVAL DOCUMENTS:

General Construction Contractor's Approval:	Date _____	N/A ☐
Electrical Construction Contractor's Approval:	Date _____	N/A ☐
Mechanical Construction Contractor's Approval:	Date _____	N/A ☐
Plumbing Construction Contractor's Approval:	Date _____	N/A ☐
Sprinkler Installation Contractor's Approval:	Date _____	N/A ☐
Asbestos Removal Contractor's Approval:	Date _____	N/A ☐
Other: _____	Date _____	N/A ☐
Other: _____	Date _____	N/A ☐
Other: _____	Date _____	N/A ☐
Certificate of Occupancy by Local Authority Having Jurisdiction (Community College):	Date _____	N/A ☐



**North Carolina
State Construction Office**

Beneficial Occupancy Inspection:	Date _____	N/A ☐
Beneficial Occupancy Punch List to be completed:	Date _____	N/A ☐
Owner's Assumption of Responsibility for Maintenance, Heat, Utilities, and Insurance:		
Comments: _____	Date _____	N/A ☐
Established Date for Guarantees and Warranties.		
Comments: _____	Date _____	N/A ☐
Consent of Surety:	Date _____	N/A ☐
Insurance Company Permitting Occupancy:	Date _____	N/A ☐
SCO Electrical Inspection (Certificate of Electrical Completion):	Date _____	N/A ☐
Installer's Fire Alarm System Record of Completion (Certification) as required by NFPA 72:	Date _____	N/A ☐
Installer's Sprinkler System Material and Test Reports as required by:		
NFPA 13-(Sprinkler Systems)	Date _____	N/A ☐
NFPA 14-(Standpipe and Hose Systems)	Date _____	N/A ☐
NFPA 20-(Centrifugal Fire Pumps)	Date _____	N/A ☐
NFPA 22-(Water Tanks for Private Fire Protection)	Date _____	N/A ☐
NFPA 24-(Private Fire Service Mains)	Date _____	N/A ☐
Other: SCO Approval Letter Sprinkler System	Date _____	N/A ☐
Engineer's Approval of Battery Powered Emergency Devices:	Date _____	N/A ☐
Engineer's Approval Emergency and Standby Generator NFPA 110 Tests:	Date _____	N/A ☐
Engineer's Approval Electrical Serv Ground Test Report:	Date _____	N/A ☐
Dept. of Labor Approval for Elevator:	Date _____	N/A ☐
Dept. of Labor Approval for Boiler & Pressure Vessels:	Date _____	N/A ☐
Dept. of Agriculture Approval for Fuel Tanks:	Date _____	N/A ☐
Health Dept. Inspection and Acceptance for Use:	Date _____	N/A ☐



**North Carolina
State Construction Office**

Domestic Water Test Report and Acceptance for Use:	Date _____	N/A ☐
Laboratory Hood Certification:	Date _____	N/A ☐
Engineer's Approval of Test and Balance Report:	Date _____	N/A ☐
Engr's. Verification Letter Fire Damper Operation:	Date _____	N/A ☐
Agreement & Means for Separation of Owner Occupied Area from Construction Work Area:	Date _____	N/A ☐
Designer's Inspection to Assure Life Safety Construction involving Fire Protection Systems (Fire Alarm, Sprinkler, etc.), egress, fire rated walls and egress travel distances are constructed in accordance with contract documents:	Date _____	N/A ☐
Backflow Preventer Certification:	Date _____	N/A ☐
Engineer's Approval Stair/Ramp Survey:	Date _____	N/A ☐
Engineer's Approval Site Survey (DENR):	Date _____	N/A ☐
Metal Building Manufacturer's Warranty:	Date _____	N/A ☐
Roofing Manufacturer's Warranty:	Date _____	N/A ☐
Commissioning Engineer's Approval:	Date _____	N/A ☐
Lightning Protection UL Master Label:	Date _____	N/A ☐
Special Inspector's Final Report/Resolutions:	Date _____	N/A ☐

Designer's Approval:	Date: _____	Printed Name: _____
Owning Agency Approval:	Date: _____	Printed Name: _____
SCO Approval:	Date: _____	Printed Name: _____



Final Acceptance Checklist

Project Name: _____

NC State Project Number: _____

NC State Code / Item: _____

SCO Project Number: _____

Item	Date	Initials
Signed Request for Final Inspection Checklist		
SCO Beneficial Occupancy Form(s) for Project's Phases		
Designer's statement to Owner the Designer's Punch List has been Completed		
SCO Final Acceptance Inspection		
SCO Final Acceptance Punch List Issued		
Contractors Work Plan for SCO Final Acceptance Punch List		
Owner's Assumption of Responsibility for Maintenance, Heat, Utilities, and Insurance		
Cancellation of Contractors Insurance Carriers Public Liability, Property Damage, and Builders Risk		
Established Date for Guarantees and Warranties		
Insurance Company Permitting Occupancy		
Record of Owner's Trainings: Plumbing HVAC/Controls Electrical Fire Alarm		
NCSU Fire Marshall's inspection of life safety systems (FAS, Sprinkler System, Emergency Generator, Fire Pumps etc)		
NCSU Lock Shop to installed permanent lock cores on Project's doors		

Date of Project's Final Acceptance: _____

Designers Approval: _____
Name Signature Date

NCSU Approval: _____
Name Signature Date

SCO Approval: _____
Name Signature Date



Project Closeout Checklist

Project Name: _____

NC State Project Number: _____

NC State Code / Item: _____

SCO Project Number: _____

Item	Date	Initials
Signed Request for Final Inspection Checklist		
Signed Final Acceptance Checklist		
Contractors Final Payment Application		
Contractors Affidavit of Release of Leins		
Contractors Affidavit of Payment of Debts & Claims		
Consent of Surety to Final Payment		
Certificates of Compliance – by each Designer who sealed documents		
Certificate of Completion – by Lead Designer		
Complete Tax Statement Form		
MBE Appendix E Form		
Survey of New & Existing Sub-surface Utilities		
All Contractors Keys Returned to Lock Shop		
NCSU Stormwater Program Manager Approval		
SCO Punch List Complete		
List of Contractors & Subcontractors		
As-Builts & Record Documents		

Designers Approval: _____
Name Signature Date

NCSU Approval: _____
Name Signature Date

SCO Approval: _____
Name Signature Date

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

CONTRACTOR: _____

Page _____ of _____

PROJECT: _____

FOR PERIOD: _____

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

* Attach subcontractor(s) report(s)

** Must balance with Detail Sheet(s)

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

Sworn to and subscribed before me,

This the _____ day of _____, 19____

Signed

Notary Public

My Commission Expires: _____

Print or Type Name of Above

Seal

NOTE:

This certified statement may be subject to audit

STATE OF NORTH CAROLINA
SALES AND USE TAX REPORT DETAIL

CONTRACTOR: _____

Page _____ of _____

SUBCONTRACTOR _____

FOR PERIOD: _____

PROJECT: _____

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

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

STORED MATERIAL SUMMARY

NC STATE UNIVERSITY

PROJECT: _____	APPLICATION PERIOD: _____
OWNER: _____	APPLICATION NUMBER: _____
A/E PROJECT NUMBER: _____	APPLICATION DATE: _____

[illegible]



FACILITIES DIVISION

REQUEST FOR UTILITY INTERRUPTION WORK SHEET

REQUESTOR

NAME : _____

DATE : _____

DEPT : _____

PHONE : _____

WORK REQ # : _____ ACCT # : _____

CAMPUS BOX : _____

BUILDING INFORMATION / DATE & TIME

BUILDING(s) : _____ ENTIRE BLDG or
SPECIFIC ROOM : _____

BEGIN DATE : _____ END DATE : _____

BEGIN TIME : _____ END TIME : _____

DISCONNECT INFORMATION

POWER

Primary ☐

Secondary ☐

RUNNING WATER

Hot ☐

Cold ☐

Distilled ☐

FIRE ALARM

Disconnect ☐

Testing ☐

Sprinkler Operational Yes / No

HEATING ☐

STEAM SYSTEMS ☐

AIR CONDITIONING ☐
(Chilled Water)

PROPANE/NATURAL GAS ☐

OTHER : _____

For all Fire Alarm / Sprinkler Disconnects or Testing, please first obtain approval from the Electronics Shop: <http://facilities.ofa.ncsu.edu/fire-alarm-disconnect/> (separate form).

REASON FOR INTERRUPTION (Scope of Work):

Shop Supervisor Signature: _____

Date: _____

Addtl. Supervisor (s) Signature: _____

POLICY # 806 – ROUTINE UTILITY INTERRUPTION REQUEST – ADV NOTIFICATION PERIODS

Primary (Total Building) Power – 10 working days

Secondary Power Feeders – 4 working days

Cold/Hot Water Interruption – 4 working days

A/C/Heat Interruption – 4 working days

*Fire Alarm Disconnect/Testing – 3 working days

Distilled Water Interruption – 3 working days

Steam Interruption – 5 working days

Gas Interruption – 5 working days

Lab Air Interruption – 4 working days

Sanitary/Storm Sewer – 3 working days

PLEASE NOTE: The Customer Service Center will make notifications for the disconnect if it is submitted within the appropriate number of days. The CSC will also make notifications for Emergency disconnects. If it is not submitted within the appropriate number of days, it is the Requestor's responsibility to make the notifications to all personnel.

Method of Procedure

Requested Start Date: DD/MM/YYYY

Requested Work Window: XX hours or YY days

Backup Dates:

1.0 Purpose / Scope of Work

1.1 The purpose of this procedure is to [description of the work to be performed].

2.0 Personnel

2.1 Contractors Personnel

2.1.1 [List Name, Title, and Contact Information for the Contractors Personnel]

2.2 NC State Personnel

2.2.1 [List Name, Title, and Contact Information for the Contractors Personnel]

2.3 Other Personnel

2.3.1 [List Name, Title, and Contact Information for the Contractors Personnel]

3.0 Planned Impact to Environment / Equipment

3.1 [Describe the intended impact of the work].

4.0 Risks & Potential Hazards

4.1 [List the risks and potential hazards associated with the work]

5.0 Stakeholders Impacted

5.1 [List the stakeholders impacted by the work]

6.0 Contingency Plan

6.1 [Describe the contingencies planned by the contractor to mitigate risks associated with the work not going according to plan.]

7.0 Attachments & References

7.1 [List the attachments associated with the MOP.]

7.2 [List the reference documents & details associated with the MOP.]

8.0 Prerequisites

8.1 [Description of Prerequisite #1.]

Prerequisite #1 is complete.

[ENTITY]:

Signature

Print Name

Date

8.2 [Description of Prerequisite #2.]

9.0 Prerequisite #2 is complete.

[ENTITY]:

Signature

Print Name

Date

PROJECT NAME
NCSU Project Number
Building Name: XYZ Hall
MOP-XXX

10.0 **Procedure**

10.1 [Step 1]

10.2 [Step 2]

10.3 [Step 3]



PRECONSTRUCTION MEETING AGENDA

Project Name: _____

Project number: _____ Code: _____ Item: _____ SCO ID #: _____

Date and location of Meeting: _____

Attendees:

1.) Introductions

2.) Correspondence Protocol:

- a. All correspondence shall have the NCSU Project Name and Number as indicated on SCO's letter of award.
- b. Owner and Contractor will endeavor to direct all communications through the Design Representative.
- c. Correspondence from Designer to Owner will be addressed to the NCSU Project Manager.
- d. Correspondence between Designer and Contractor requires copy to the NCSU Project Manager.
- e. Correspondence from Owner and Contractor to Designer will be addressed to the Design Representative.

3.) Schedule

- a. Bar chart, Network plots. Project schedule, signed by all major subcontractors, is due to the designer within 30 calendar days of the notice to proceed. A Schedule of Values shall be submitted within 30 calendar days of the notice to proceed.
- b. Monthly schedule updates, signed by all major subcontractors, shall be required with each payment application.
- c. Milestones:

Notice to Proceed Date: _____

Project Start Date: _____

Duration: _____

Project Completion Date: _____

Adjustment(s) to the completion of a project will only be allowed by a justifiable change order approved by the designer, the owning agency and the State Construction Office.

One copy of the approved schedule is to be posted at the project site and marked daily showing actual progress of the work.

The submission of an approved schedule and schedule of values to the designer shall occur prior to submitting the first request for payment. The schedule of Values shall include dollar value of each subcontractor and shall identify MBE subcontract work.

A list of subcontractors and material suppliers are to be provided to the designer with a copy for the State Construction Office within 14 days of the notice to proceed in accordance with article 16 of the general conditions.

- d. Weather Delays: The general conditions states the contractual method by which the contractors were to use to establish the expected number of weather days to include in the contract(s). For weather impact greater than what is in the contract, the contract is due to be adjusted. The contractors' project administrators should develop a daily log on construction events covering construction progress and daily weather conditions that affect the construction progress. Copies of the logs should be directed to the designer's representative on a weekly basis for his initial. Copies of the logs should be turned in to the designer on a monthly basis with a request for weather time extensions if justifiable. The requests will be evaluated and approved by the designer, owning agency and State Construction Office if deemed valid. The designer shall keep a running total of time of weather relating delays for granting one change order per prime contract at the end of the project for contract adjustment to the date of completion of the project.
- e. Liquidated Damages: The contract contains a clause allowing an assessment of a sum of _____ dollars per day as liquidated damages for each calendar day the project construction is delayed beyond the adjusted scheduled completion date.
- f. It is important all prime contractors become familiar with the general and the supplementary general conditions of the contract(s).

4.) Progress Meetings

- a. SCO/Owner's/Designer's Regular monthly progress meetings will be held on:

Location: _____

Time: _____

Prime contractors shall be represented by office and project representatives having the authority to make bindings contractual decisions on the contract. The meetings are open to subcontractors, material suppliers and others that may contribute to the progress toward project completion. The meetings are to enhance coordination, to enhance cooperation, to assist the support of the project schedule, to facilitate in the resolution of problems, and to review pending changed conditions.

- b. Contractor's regular weekly progress meetings will be held on:

Location: _____

Time: _____

Meeting Agenda. A sample agenda for these meetings is included in the Project Manual.

5.) Change Orders

For Changes in the Work - follow General Conditions Article 19 and see Attachment 2:

- a. Provide breakdown of materials, labor rates, and correct OH&P

- b. Each request will be identified as "change proposal" or "change request" and will be number consecutively.
- c. Designer will prepare field orders to the Contract on State Construction Office forms.
- d. Owner and Designer will prepare change orders to the Contract on State Construction Office forms or using SCO Interscope Website to process electronically.
- e. Designer shall maintain a change order log.
- f. ***Time extension requests must be supported by a marked-up schedule showing the impact of the delay(s) on the critical path.***
- g. The University requires 6 original change orders for processing.
- h. Only the designer has the authority to issue change orders to change the work of Contractor
- i. All User or other departmental requests for changes in the work will be channeled through the N.C.S.U. Project Manager to the designer as necessary.

6.) Pay Applications/Schedule of Values:

- a. Shall be submitted on *AIA G702 forms*. Applications submitted on any different format will be returned *NOT APPROVED*. The University requires three originals only.
- b. A copy of *NC Sales Tax Report* shall be included with each pay application.
- c. Contractor will submit pay applications to the Designer for approval.
- d. Submittal date to designer will be: _____.
- e. Schedule of values *must be approved by Designer and Owner* prior to first pay application.
- f. Pay applications must clearly identify the type of contract (general, mechanical, plumbing, electrical, etc.). Project name, code and item number, NCSU project number, and SCO ID number must be shown.
- g. All Pay Applications must be accompanied by a *Consent of Surety* and up to date *MBE (HUB) Form*.
- h. Contractor's pay applications are due at Capital Project Management by the fifth of each month.
- i. A copy of the payment application will be submitted to the SCO Project Monitor.

7.) Project Close-Out:

The following must all be complete and included:

- a. As-Builts, including registered survey and certification of stairs.
- b. O&M Manuals
- c. Special Inspections Report
- d. Consent of Surety
- e. Affidavit of Payment of Debts and Claims and Lien waivers
- f. Special warranties/bonds, certificates of completion and compliance
- g. Certification of equipment demonstrations and training for Owner personnel.
- h. Commissioning of building systems if required
- i. Contractor and Designer evaluations

8.) Personnel Conduct

- a. Zero tolerance for harassment of any sort of any member of the University community.
- b. Smoking Policy - No smoking inside of existing facility or addition.
- c. Protection/Safety
 - 1.) OSHA Regulations:
 - a) Fire control
 - b) Barricades - work areas, excavation, pedestrian access, etc.
 - c) Housekeeping - keep site clean, keep mud off streets daily
 - 2.) Working in and around occupied facilities - must be sensitive to the needs of occupants. Coordinate with Project Manager. Noise hours.
 - 3.) Scheduling of cutting of floors in occupied spaces. Precaution to protect activities in floors below
 - 4.) Hot Work Permits: Fire Marshals Office: 515-2568
 - 5.) Contractors shall familiarize themselves with article 11 of the general conditions. The requirements are a mandatory part of the contract.
- d. Accident Reports - Owner requires copy of First Report of Injury.
- e. It is illegal for any person to have firearms at the project site, any type of alcoholic beverages, or drugs other than prescribed by a physician. Everyone at the project site is expected to exhibit proper behavior. Indecent language, acts or dress will not be accepted. Anyone in violation of proper behavior will be ejected from the construction site by the proper authorities.

9.) Temporary Services and Facilities:

- 1.) Sanitary:
- 2.) Water:
- 3.) Power:
- 4.) Heat:
- 5.) Telephone:
- 6.) Trailers:
- 7.) Job Sign:
- 8.) Parking:
- 9.) Waste Disposal Dumpster:
- 10.) Restroom facilities are to be:
- b. Service Continuity:
 - 1.) All interruption of services will be coordinated through the NCSU project manager
 - 2.) Contractor will not interrupt existing services, i.e., Owner will throw switches, turn valves, etc.
 - 3.) 5 days minimum notice, longer for major utility outages, up to 10 days for high voltage or building electricity interruptions.
- c. Cleaning of Streets - any mud, debris, etc., will be removed by Contractor daily.

- d. Site Considerations:
 - 1.) Project limits and staging - see drawings.
 - 2.) Store materials properly.
 - 3.) Erosion control.
 - 4.) Tree protection.
 - 5.) Concrete wash-down areas - keep clean - do not wash out near trees, storm drain inlets.
 - 6.) Pre-Excavation Process:
 - a) The Contractor shall lay out excavations.
 - b) The Contractor shall be responsible for having existing utilities located.
 - c) The Contractor may start excavation only when all known utilities have been located or verified as per the specifications.

10.) Special Requirements of the Owner:

- a. Asbestos:
 - 1.) If applicable, Owner will survey for, and deal with asbestos removal prior to work on this contract commencing.
 - 2.) If the Contractor encounters any material that is suspected to be asbestos, work will cease immediately in the area, and the area will be barricaded, etc.
 - 3.) Owner shall be notified immediately if the presence of asbestos is suspected.
- b. Submittals:
 - 1.) Submit ___ copies to Designer. NCSU requires one full set of approved submittals at the end of the project.
 - 2.) Submittals to be numbered consecutively and specification section will be referenced.
 - 3.) Contractor approval stamp required prior to submission to the Designer.
 - 4.) Designer shall maintain submittal log.
 - 5.) *See Attachment 3 for a list of Submittals to be reviewed by the owner.*
- c. Requests For Information:
 - 1.) Contractor is responsible for thoroughly reviewing contract documents prior to request for information.
 - 2.) Designer shall maintain a RFI (request for information) log.
- d. Normal working Hours: _____

11.) Final Inspections:

- a. State Inspections must be complete and approved. (SCO Electrical, NFPA Testing, and DOL: elevator, boilers, pressure vessels, etc.)
- b. Satisfactory review of project completeness by the Designer.
- c. The designer shall coordinate and notify all parties of the time and date of the formal final inspection.

- d. Upon correction by the contractor and verification by the designer that the work has been completed, a formal final inspection shall be coordinated and performed by the designer in cooperation with the contractor in the presence of the owning agency and the State Construction Office.

12.) As-Built Drawing:

- a. Contractor to keep record set of drawings on site for record drawing purposes exclusively.
- b. Designer and Owner will review the record drawings once a month at construction meeting.

13.) State Construction Office Requirements: Show project SCO ID on all correspondence. Provide a copy of all designers' weekly inspection reports to the project monitor.



MONTHLY MEETING AGENDA

Project Name: _____
Project number: _____ Code: _____ Item: _____ SCO ID #: _____

Date and location of Meeting: _____

Attendees:

- 1.) Review previous minutes of the meeting and resolve any corrections.
- 2.) Work performed in the last 30 days.
- 3.) Work to be performed in the next 30 days.
 - a. Review Project Schedule Summary and attach to the meeting minutes.
 - b. Review updated schedule and attach to the meeting minutes.
 - c. Review Monthly Progress Summary and attach to the meeting minutes.
- 4.) Requests for Proposals.
- 5.) Review Pending Change Orders. Attach an updated Change Order Log to the meeting minutes.
- 6.) Review Requests for Information. Attach an updated RFI log to the meeting minutes.
- 7.) Review Submittals. Attach an updated Submittal Log to the meeting minutes.
- 8.) Discuss Coordination Issues.
- 9.) Designer Weekly Inspection Reports.
- 10.) Erosion Control & Tree Protection Review.
- 11.) Site Cleanliness.
- 12.) Safety.
- 13.) Open Discussion.
- 14.) Attach photos of work progress, taken within two days of the meeting, to the meeting minutes.



PROJECT SCHEDULE SUMMARY

Notice to Proceed Date	_____
Contract Completion Date	_____
Contract Calendar Days	_____
Number of Contract Calendar Days Expended to Date Thru __/__/__	_____
Percentage of Contract Time Expended to Date Thru __/__/__ (Days Expended/Contract Duration)	_____
Previous Percentage of Contract Time Expended to Date	_____
Pending Time Extensions (Weather – Calendar Days)	_____
Pending Time Extensions (Scope – Calendar Days)	_____
Approved Time Extensions (Weather – Calendar Days)	_____
Approved Time Extensions (Scope – Calendar Days)	_____
Completion Date per Updated Schedule	_____
Actual Percentage Complete (Work in Place less stored Materials) thru __/__/__	_____ _____
Previous Percentage Complete	_____



MONTHLY CONSTRUCTION PROGRESS REPORT

Designer		Address	
Location		Date	
Job Title		Starting Date	
SCO ID#			

PERCENT COMPLETION

	% Previous Month	% This Month	% Total to Date	% Scheduled	Completion Date
General Contract					
Plumbing Contract					
Mechanical Contract					
Electrical Contract					

Change Orders Since Last Report:

Change Order Number	Amount	Purpose

Insurance up to Date: Yes ____ No ____
Explanation (if no):

Financial Status:	Previously Authorized	Authorized This Month	Total Contract Inc. Extras	% of Total Authorization
General				
Plumbing				
Mechanical				
Electrical				
Totals				

If work is behind schedule, what action has been taken?



WEEKLY MEETING AGENDA

Project Name: _____
Project number: _____ Code: _____ Item: _____ SCO ID #: _____

Date and location of Meeting: _____

Attendees:

- 1.) Contractor's Construction Schedule:
 - a. 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.
 - b. Review schedule for the upcoming two-week period.
 - c. Discuss long-term schedule needs as necessary.
- 2.) Safety, hazards and risks.
- 3.) Change Order Requests and Change Orders.
- 4.) Request for Information.
- 5.) Submittals.
- 6.) Designer Inspection Reports.
- 7.) Erosion & Sedimentation Update (if applicable).
- 8.) Review condition of tree protection (if applicable).
- 9.) Progress cleaning and site cleanliness.
- 10.) Changes to Site Logistics or Emergency Action Plan.
- 11.) Sequence of operations.
- 12.) Resolution of BIM component conflicts.
- 13.) Status of upcoming samples and/or mockups, and location for review.
- 14.) Deliveries.
- 15.) Off-site fabrication.
- 16.) Access.
- 17.) Site utilization.



- 18.) Temporary facilities and controls.
- 19.) Atypical work hours.
- 20.) Quality and work standards.
- 21.) Pending changes
- 22.) Pending claims and disputes.
- 23.) Documentation of information for payment requests.
- 24.) Testing and inspection requirements.
- 25.) Other business relating to the Work.

NC State University Lift Plan Approval Request

Date Submitted: _____

Submitted by: _____

NCSU Group Leading Project: _____

Lift Date: _____

-
- The identity of the controlling entity, meaning the employer with the overall responsibility for construction operations associated with the crane lift.
 - Identify a lift director (i.e. primary signal person) and method of communication (hand signals, radio, etc.).
 - Contractors conducting crane operations are required to obtain required FAA permits according to 14.CFR Part 77; to be submitted with the lift plan.
 - Equipment positioning locations, including load staging and movement and paths to and from the working position
 - Equipment specifications including load and reach capacities
 - Current qualifications, certifications, and licenses of operator(s) and rigger(s)
 - For lifts involving more than one crane, the lift plan shall encompass all cranes.
 - Fall Zone: The contractor shall identify the Fall Zone. The Fall Zone is the area (including but not limited to the area directly beneath the load) in which it is reasonably foreseeable that partially or completely suspended materials could fall. Spaces within the Fall Zone (including buildings, foot traffic, vehicle traffic, etc.) shall be barricaded to control access. The Fall Zone shall be cleared of personnel not participating in the lift.
 - Wind limitations
 - Ground and subsurface stability at crane and load placement locations. The contractor must ensure a qualified person evaluates the crane set-up location to ensure ground conditions are sufficient.
 - Other conditions or factors that may affect the safety of the lift
 - A pre-lift meeting must be completed immediately before the lift and shall include all personnel involved with the lift and a thorough review of the elements and specifics of the lift plan and personnel assignments.
 - Specify distance to closest energized lines and applicable minimum approach distance of any lift component.
 - Where items positioned by a crane lift are rigged at heights above easy reach height, the lift plan shall include safe attachment and de-attachment procedures and the control of exposure to fall hazards
 - The contractor must provide documentation of annual and monthly inspections for the previous 3 months. 1926.1412(f) & .1412(e)

Reviewed by: _____

Review Date _____

- **Approved**
- **More Information Needed**
- **Denied**



C&D WASTE AND RECYCLING TRACKING FORM

The University requires 75% of the waste produced from each project be diverted from the landfill

Project Name & ID: _____

Name of Contractor: _____

Project Manager Name: _____

Contractor Phone #: _____

For assistance completing this form contact Adam Bensley, NCSU Waste Reduction & Recycling (919) 515-0661

Name of Person Completing Form: _____

It is required to attach weight tickets and/or invoices to this form.

Please check one: ☐ Weight tickets attached ☐ Weight tickets not attached. Provide explanation: _____

Date	Waste Hauler/Contractor Name	Material Description	Weight (lbs or tons)	Estimate Weight if no Ticket	Recycling or Landfill Facility Hauled to

Project Totals (Contractor to Calculate)

Total Weight Landfill: _____

Total Weight Diverted (Recycled + Salvaged): _____

Percent of Project Waste Diverted from Landfill
(Total Weight Diverted / Total Project Weight) x 100

Total Weight Recycled: _____

Total Project Weight (Recycled + Salvaged + Landfilled): _____ %

Instructions for completing this form

1. NCSU project manager to provide info.
2. Contractor to provide this information, including name of person completing this form.
3. Check a box indicating whether weight tickets are attached to this form. If they are not, provide an explanation.
4. Complete one line for each instance of hauling.

A. List the date material was hauled.

B. Provide name of waste hauler or contractor who disposed or recycled the material.

C. List the type of material disposed of or recycled. Ex. Mixed C&D waste, scrap metal, concrete, asphalt shingles, etc.

D. List the actual weight of the material, in pounds or tons, as recorded by a scale.

E. If material is not weighed by a scale, provide an estimate of the weight in pounds or tons (keep units consistent throughout).

F. List the facility the material was delivered to.
5.

A. Provide the total weight of all materials that went to a landfill. *Note:* For Waste Industries Raleigh View Road C&D Processing Facility *only* - 20% of each load is recycled. Multiply the weight recorded at this facility by .80 to get the weight landfilled by Waste Industries.

B. Provide the total weight of materials that were recycled. *Note:* For Waste Industries Raleigh View Road C&D Processing Facility *only* - 20% of each load is recycled. Multiply the weight recorded at this facility by .20 to get the weight recycled by Waste Industries.

C. Total weight recycled (B) plus total weight salvaged (*#8 on Salvaged Material form*).

D. Total weight of all material generated by the project (A+B+C).

E. Divide the total weight diverted by the total project weight, then multiply by 100 to get the diversion rate as a percent ((C/D) x 100).



C&D WASTE AND RECYCLING TRACKING FORM

The University requires 75% of the waste produced from each project be diverted from the landfill

1. Project Name & ID: _____

Project Manager Name: _____

2. Name of Contractor: _____

Contractor Phone #: _____

Name of Person Completing Form: _____

For assistance completing this form contact Adam Bensley, NCSU Waste Reduction & Recycling (919) 515-0661

It is required to attach weight tickets and/or invoices to this form.

3. Please check one: ☐ Weight tickets attached ☐ Weight tickets not attached. Provide explanation: _____

4.

Date	Waste Hauler/Contractor Name	Material Description	Weight (lbs or tons)	Estimate Weight if no Ticket	Recycling or Landfill Facility Hauled to
A	B	C	D	E	F

Project Totals (Contractor to Calculate)

5. Total Weight Landfill: **A** Total Weight Diverted (Recycled + Salvaged): **C** Percent of Project Waste Diverted from Landfill (Total Weight Diverted / Total Project Weight) x 100

Total Weight Recycled: **B** Total Project Weight (Recycled + Salvaged + Landfilled): **D** **E** %

Description Of Program: The University has established a program to salvage building materials, parts and furnishings that would otherwise be considered construction and demolition waste. Prior to the beginning of construction and renovations projects on campus, Facilities Operations and other Donees will have an opportunity to reclaim C&D materials for reuse.

Facilities Operations Trade shops will have first priority in the invitation to salvage materials from construction and renovation projects. Other donees, such as Habitat for Humanity may receive donation of reusable materials. The following conditions and procedure must be met in order to participate in the salvaged material/ reuse program.

Criteria:

Clear understanding of the purpose of the salvaged material/ reuse program.

Tracking the salvaged materials is extremely important to protect all participants from possible liability claims or false acquisition of materials by shops or donees.

Shop or donee is responsible for removal and transportation of materials.

Shop or donee has adequate second use or storage for the materials.

Shop or donee takes responsibility for the timely and lawful surplus or disposal of materials if an adequate reuse is not identified in an appropriate amount of time.

Questions? Contact WRR at 919.515.9421 or recycling@ncsu.edu

Return completed form to Waste Reduction and Recycling. Campus Box 7516 or recycling@ncsu.edu



CONSTRUCTION & DEMOLITION SALVAGED MATERIAL FORM

Project Name & ID: _____

Project Manager Name: _____

For assistance completing this form contact Adam Bensley, NCSU Waste Reduction & Recycling (919) 515-0661

Date	Material Description	Quantity	Weight Each Item (lbs or tons)	Estimated Donation Value	Released By (NCSU)	Released To & Phone #

Total Salvaged Material Weight: _____

Instructions for completing this form

6. NCSU project manager to provide info.
7. Complete one line for each item salvaged for reuse.

A. List the date salvaged material was turned over to the receiving party.
B. Describe the material being salvaged for reuse.
C. Quantity of a particular item was salvaged.
D. Weight of each item, either actual or estimated.
E. Estimate the value of the material. If you are unsure, leave this blank.
F. List the name of the person at NCSU who is releasing the material.
G. List the name and phone number of the person who is receiving the material.
8. Add up the total weight of material salvaged. Keep the units (tons or pounds) consistent with those used on C&D waste tracking form, as this number will be used in the diversion rate equation.



CONSTRUCTION & DEMOLITION SALVAGED MATERIAL FORM

6.

Project Name & ID: _____

Project Manager Name: _____

For assistance completing this form contact Adam Bensley, NCSU Waste Reduction & Recycling (919) 515-0661

7.

Date	Material Description	Quantity	Weight Each Item (lbs or tons)	Estimated Donation Value	Released By (NCSU)	Released To & Phone #
A	B	C	D	E	F	G

8.

Total Salvaged Material Weight: _____

GENERAL CONDITIONS OF THE CONTRACT

STANDARD FORM FOR CONSTRUCTION MANAGER-AT-RISK PROJECTS

NORTH CAROLINA

DEPARTMENT OF ADMINISTRATION

STATE CONSTRUCTION OFFICE

Form OC-15CM

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

Second Edition January 2013

Revision 1 – May 2024: Article 23.b

GENERAL CONDITIONS OF THE CONTRACT

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

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ARTICLE 1 - DEFINITIONS

- a. The **contract documents** consist of the Request for Proposal (RFP); Construction Manager's formal response to the RFP; General Conditions of the Contract; special conditions if applicable; Supplementary General Conditions; the drawing and specifications, including all bulletins, addenda or other modifications of the drawings and specifications incorporated into the documents prior to their execution; the contract; the performance bond; the payment bond; insurance certificates; the approval of the attorney general; and the certificate of the Office of State Budget and Management. All of these items together form the contract.
- b. The **Owner** is the State of North Carolina by and through the agency or institution named in the contract..
- c. The **designer** or **project designer** means the firm or firms of architects or engineers or both (and their consultants) which have undertaken to design the project pursuant to a contract with the Owner, (hereinafter, the "design contract").
- d. The **Construction Manager-at-Risk (CM)** accepts a relationship of trust and confidence between himself and the Owner and undertakes to act as the Owner's fiduciary in the handling and opening of bids in accordance with the provisions of North Carolina General Statute (N.C.G.S.) 143-128.1. The CM agrees to furnish his best skills and his best judgment to cooperate with the Owner and Designer for undertaking all necessary action contemplated under the contract documents to (a) establish during the design phase a Guaranteed Maximum Price (GMP) to construct the project and (b) ensure timely and quality completion of the project at a cost within the GMP. Construction Manager or CM as used in the contract documents means Construction Manager-at-Risk (CM at Risk).
- e. A **subcontractor**, as the term is used herein, shall be in the case of a principal trade contractor, a general, mechanical, electrical or plumbing contractor or in the case of a specialty contractor, a trade contractor who is not a principal trade contractor, who has entered into a direct contract with a CM, 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 as supervised by the CM.
- h. The **project** is the total construction work to be performed under the contract documents.
- i. **Construction Management Fee** shall be an all inclusive lump sum management fee which will include all Construction Manager-at-Risk home office, project site and project related costs including all Construction Manager-at-Risk overhead costs and profit.
- j. **Change order**, as used herein, shall mean a written order to the CM subsequent to the signing of the contract authorizing a change in the GMP contract. The change order shall be signed by the CM, designer and the Owner, and approved by the State Construction Office, in that order (Article 19).

- k. **Field Order**, as used herein, shall mean a written approval for the CM to proceed with the work requested by Owner prior to issuance of a formal Change Order. The field order shall be signed by the CM, designer, Owner, and State Construction Office (SCO).
- l. **Field Change**, as used herein shall mean a written approval from the Owner for the CM to proceed with work requested by the Owner to be paid for from the CM Contingency or Owner's Project Reserve within the GMP.
- m. **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).
- n. **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 CM 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 CM, or consequential damages that the Owner identified in the bid documents that may be impacted by any delay caused solely by the CM (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).
- o. **Surety**, as used herein, shall mean the bonding company or corporate body which is bound with and for the CM, and which engages to be responsible for the CM and his acceptable performance of the work.
- p. **Routine written communications between the Designer and the Construction Manager** 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".
- q. **Clarification or Request for information (RFI)** is a request from the CM 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 CM's interpretation or understanding of the contract documents requirements in question, along with reasons for such an understanding.
- r. **Approval** means written or imprinted acknowledgement that materials, equipment or methods of construction are acceptable for use in the work.
- s. **Inspection** shall mean examination or observation of work completed or in progress to determine its compliance with contract documents.
- t. **"Equal to" or "approved equal"** shall mean materials, products, equipment, assemblies, or installation methods considered equal by the bidder in all characteristics (physical, functional, and aesthetic) to those specified in the contract documents. Acceptance of equal is subject to approval of the designer and owner.

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

ARTICLE 2 - INTENT AND EXECUTION OF DOCUMENTS

- a. The drawings and specifications are complementary, one to the other. That which is shown on the drawings or called for in the specifications shall be as binding as if it were both called for and shown. The intent of the drawings and specifications is to establish the scope of all labor, materials, transportation, equipment, and any and all other things necessary to provide a complete job. In case of discrepancy or disagreement in the contract documents, the order of precedence shall be: Form of Contract, specifications, large-scale detail drawings, small-scale drawings.
- b. The wording of the specifications shall be interpreted in accordance with common usage of the language except that words having a commonly used technical or trade meaning shall be so interpreted in preference to other meanings.

- c. The CM shall execute each copy of the response to RFP, 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 construction manager'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 CM's signature on the performance bond and the payment bond shall correspond with that on the contract.

ARTICLE 3 - CLARIFICATIONS AND DETAIL DRAWINGS

- a. In such cases where the nature of the work requires clarification by the designer, such clarification shall be furnished by the designer with reasonable promptness by means of written instructions or detail drawings, or both. Clarifications and drawings shall be consistent with the intent of contract documents, and shall become a part thereof.
- b. The CM 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 CM 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 CM electronic copies of plans and specifications. If requested by the CM, up to 30 paper copies of plans and specifications will be

provide free of charge,, plus a clean set of black line prints on white paper of all appropriate drawings, upon which the CM shall clearly and legibly record all work-in-place that is at variance with the contract documents. Additional sets shall be furnished at cost, including mailing, to the CM at the request of the CM.

ARTICLE 5 - SHOP DRAWINGS, SUBMITTALS, SAMPLES, DATA

- a. Within fifteen (15) consecutive calendar days of the notice to proceed, a schedule for anticipated submission of all shop drawings, product data, samples, and similar submittals shall be prepared by the CM and provided 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 CM 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 CM'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 CM. 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.
- c. The Designer shall review required submittals promptly, noting desired corrections if any, and retaining three (3) copies (1 for the Designer, 1 for the owner and 1 for SCO) for his use. The remaining copies of each submittal shall be returned to the CM not later than twenty (20) days from the date of receipt by the Designer, for the CM'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 by the designer shall not be construed as relieving the CM 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 error has been called to the attention of the designer in writing by the CM.

ARTICLE 6 - WORKING DRAWINGS AND SPECIFICATIONS AT THE JOB SITE

- a. The CM shall maintain, in readable condition at his job office, one complete set of working drawings and specifications for his work including all shop drawings. Such drawings and specifications shall be available for use by the Designer or his authorized representative, owner or State Construction Office.
- b. The CM 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 CM and submitted to the designer upon project completion and no later than thirty (30) days after acceptance of the project.
- c. The contractor shall maintain at the job office a record of all required tests that have been performed, clearly indicating the scope of work inspected and the date of approval or rejection.

ARTICLE 7 - OWNERSHIP OF DRAWINGS AND SPECIFICATIONS

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

ARTICLE 8 - MATERIALS, EQUIPMENT, EMPLOYEES

- a. The CM shall, unless otherwise specified, supply & pay for all lighting, power, heat, sanitary facilities & water and shall require the Principal Trade and Specialty Contractors to, supply and pay for all labor, transportation, materials, tools, apparatus, scaffolding and incidentals necessary for the completion of his work, and to 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. The CM 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 there from, 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 CM shall furnish evidence from the the Principal Trade and Specialty Contractors 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 CM through the Principal Trade or Specialty Contractor may select any product meeting this standard, by any manufacturer. When several products or manufacturers are specified as being equally acceptable, the CM through the Principal Trade or Specialty Contractor has the option of using any product and manufacturer combination listed. However, the CM through the Principal Trade or Specialty 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. The CM shall be responsible for reviewing all substitution requests from Principal Trade or Specialty Contractors prior to submission to the Project Designer and Owner and shall track & monitor all such requests. Requests for substitution of materials, items, or equipment shall be submitted to the Project 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 award if it can clearly be demonstrated that it is an added benefit to the owner and the designer and the owner approves.
- e. The CM shall obtain written approval from the designer for the use of products, materials, equipment, assemblies or installation methods claimed as equal to those specified. Such approvals must be obtained as soon after contract awards as possible and before any materials are ordered.

- f. The Designer is the judge of equality for proposed substitution of products, materials or equipment.
- g. If at any time during the construction and completion of the work covered by these contract documents, the conduct of any workman of the various crafts be adjudged a nuisance to the Owner or Designer, or if any workman be considered detrimental to the work, the CM 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 CM shall protect and save harmless the Owner against suit on account of alleged or actual infringement. The CM 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 CM 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 CM observes that the drawings and specifications are at variance therewith, he shall promptly notify the Designer in writing. Any necessary changes required after contract award shall be made by change order in accordance with Article 19. If the CM performs any work or authorizes any work to be performed 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 there from. 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 CM unless otherwise specified.
- 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 CM 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 (Community Colleges) are also subject to county and municipal building codes and inspection by local authorities. The CM shall pay the cost of these permits and inspections unless otherwise specified.

ARTICLE 11 - PROTECTION OF WORK, PROPERTY AND THE PUBLIC

- a. The CM shall be 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. The CM 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. The CM shall be responsible for and pay for any damages caused to the Owner. The CM shall have access to the project at all times.

- b. The CM shall be responsible to 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. Any work damaged through the lack of proper protection or from any other cause, shall be repaired or replaced without extra cost to the Owner.
- c. No fires of any kind will be allowed inside or around the operations during the course of construction without special permission from the Designer.
- d. The CM shall ensure that all trees and shrubs designated to remain in the vicinity of the construction operations are protected in accordance with the requirements of the plans and specifications. All walks, roads, etc., shall be barricaded 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 CM shall develop and implement a project safety plan that provides 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. The CM shall clearly mark or post signs warning of hazards existing, and shall barricade excavations, elevator shafts, stairwells and similar hazards. The CM shall insure that protection is provided against damage or injury resulting from falling materials and that all protective devices and signs be maintained throughout the progress of the work.
- f. The CM 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 N.C.G.S. 95-126 through 155.
- g. The CM shall designate a responsible person of his organization as safety officer/inspector to inspect the project site for unsafe health and safety hazards, to report these hazards to the contractor for correction, and whose duties also include accident prevention on the project, and to provide other safety and health measures on the project site as required by the terms and conditions of the contract. The name of the safety inspector shall be made known to the designer and owner at the time of the preconstruction conference and in all cases prior to any work starting on the project.
- h. In the event of an emergency affecting the safety of life, the protection of work, or the safety of adjoining properties, the CM 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 CM on account of such action shall be determined as provided for under Article 19(b).
- i. Any and all costs associated with correcting damage caused to adjacent properties of the construction site or staging area shall be borne by the contractor. These costs shall include but not be limited to flooding, mud, sand, stone, debris, and discharging of waste products.

ARTICLE 12 - SEDIMENTATION POLLUTION CONTROL ACT OF 1973

- a. Any land-disturbing activity performed by the CM or any Principal Trade or Specialty Contractor 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 CM 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 CM 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 CM shall indemnify and hold harmless the Owner, the designer and the agents, consultants and employees of the Owner and designer, from and against all claims, damages, civil penalties, losses and expenses, including, but not limited to, attorneys' fees, arising out of or resulting from the performance of work or failure of performance of work, provided that any such claim, damage, civil penalty, loss or expense is attributable to a violation of the Sedimentation Pollution Control Act. Such obligation shall not be construed to negate, abridge or otherwise reduced any other right or obligation of indemnity which would otherwise exist as to any party or persons described in this article.

ARTICLE 13 - INSPECTION OF THE WORK

- a. It is a condition of this contract that the work shall be subject to inspection during normal working hours by the designer, designated official representatives of the Owner, State Construction Office and those persons required by state law to test special work for official approval. The CM shall therefore provide safe access to the work at all times for such inspections.
- b. All instructions to the CM 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 CM.
- c. The CM shall perform quality control inspections on the work of Principal Trade and Specialty Contractors to guard the Owner against defects and deficiencies in the work and shall coordinate this activity with the on-site duties of the Project Designer. The CM shall advise the Project Designer of any apparent variation and/or deviation from the intent of the Contract Documents and shall take the necessary action to correct such variations and deviations.
- d. All work shall be inspected by designer, special inspector and/or State Construction Office prior to being covered by the contractor. The CM shall give a minimum two weeks notice unless otherwise agreed to by all parties. If inspection fails, after the first re-inspection all costs associated with additional re-inspections shall be borne by the CM.
- e. Where special inspection or testing is required by virtue of any state laws, instructions of the designer, specifications or codes, the CM shall give adequate notice to the Project Designer of the time set for such inspection or test, if the inspection or test will be conducted by a party other than the Project Designer. Such special tests or inspections will be made in the presence of the Project Designer, or his authorized representative, and it shall be the CM's responsibility to serve ample notice of such tests.

- f. All laboratory tests shall be paid by the Owner unless provided otherwise in the contract documents except the CM 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.
- g. Should any work be covered up or concealed prior to inspection and approval by the Project Designer and/or (SCO) such work shall be uncovered or exposed for inspection, if so requested by the Project Designer or SCO in writing. Inspection of the work will be made promptly upon notice from the CM. 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 CM.

ARTICLE 14 - CONSTRUCTION SUPERVISION AND SCHEDULE

- a. On-site representatives of the CM shall manage the work of the Principal Trade and Specialty Contractors and coordinate the work with the activities of the Owner and Project Designer to complete the project with the Owner's objectives of cost, time and quality. Throughout the progress of the work, the CM shall maintain a competent and adequate full-time staff approved by the Owner and Project Designer. It is understood that the designated and approved on-site representative of the CM will remain on the job and in responsible charge as long as those persons remain employed by the CM unless otherwise requested or agreed to by the Owner. The CM shall establish an on-site organization with appropriate lines of authority to act on behalf of the CM. Instructions, directions or notices given to the designated on-site authority shall be as binding as if given to the CM. However, directions, instructions, and notices shall be confirmed in writing.
- b. The CM 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. The CM shall call and preside over monthly job site progress conferences. All Principal Trade and Specialty Contractors shall be represented at these job progress conferences by both home office and project personnel. The CM shall require attendance from other subcontractors and material suppliers 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. The CM shall be prepared to assess progress of the work and to recommend remedial measures for correction of progress as may be appropriate. The CM with assistance from the Designer shall be the coordinator of the conferences and shall preside as chairman. The CM shall turn over a copy of his daily reports to the Designer and Owner at the job site progress conference. Owner will determine daily report format.
- d. The CM 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 nearby in a location where same will not be disturbed and where direct instruments sights may be taken.

- e. Prior to bidding, it shall be the responsibility of the CM to prepare an electronic and paper copy of a preliminary critical path method (CPM) schedule and submit such schedule to the Project Designer for his review and comment in sufficient time to allow revisions prior to inserting said schedule into the Principal Trade and Specialty Contractors' bid packages. After contract award but prior to thirty (30) days from the date of the notice to proceed, the CM shall obtain from the Principal Trade and Specialty Contractors their respective work activities and integrate them into a project construction schedule in CPM form. The resulting CPM schedule shall show all salient features of the work required for construction of the project from start to finish within the time allotted by the contract. The time in days between the CM's early completion date and the contractual completion date is project float time and shall be used as such by the CM unless amended by change order. The CM shall submit to the Project Designer an electronic and paper copy of the final CPM schedule after contracts are executed but within fifteen (15) days prior to the written notice to proceed. The Project Designer after reviewing and commenting on the project CPM schedule shall submit it to the Owner for approval. No application for payment will be processed until the project CPM schedule is approved by the Owner. No monthly application for payment will be processed without the submission of an electronic and paper copy of the CPM schedule attached.
- f. The CPM schedule shall be a complete computer generated network analysis showing the complete sequence of construction activities, identifying the work of separate stages and other logically grouped activities, indicating early and late start and early and late finish dates, float duration and a complete logic. Monthly updates will show the estimated completion of each activity.
- g. The CM shall distribute to the principal trade and specialty contractors the approved project CPM schedule and shall display same at the job site.
- h. The CM shall maintain the project CPM schedule, making monthly adjustments, updates, corrections, etc., which are necessary to finish the project within the time allotted by the contract. In doing so, the CM shall keep the designer as well as all Principal Trade and Specialty Contractors fully informed as to all changes and updates to the schedule. The CM shall submit to the Project Designer a monthly report of the status of all work activities. The monthly status report shall show the actual work completed to date in comparison with the original amount of work scheduled. If the work is behind schedule, the CM must indicate in writing what measures are being taken to bring the work back on schedule and ensure that the contract completion date is not exceeded. If the work is greater than thirty (30) days behind schedule and no legitimate requests for time extensions are in process, then the CM shall prepare and submit to the Project Designer a recovery schedule for review and approval. Failure of the CM to abide by the directives in this paragraph will give the Owner cause to exercise the remedies set forth in Article 29 of the General Conditions and pursue any other legal remedies allowed it by law.

ARTICLE 15 – {NOT USED}

ARTICLE 16 - PRINCIPAL TRADE AND SPECIALTY CONTRACTS AND CONTRACTORS

- a. Principal Trade and Specialty Contractors shall be pre-qualified by the CM. The prequalification criteria shall be determined by the Owner and CM to address quality, performance, the time specified in the bids for performance of the contract, the cost of construction oversight, time for completion, capacity to perform, and any other factors deemed appropriate by the Owner and/or CM. Basic qualification information from Principal Trade and Specialty Contractors shall be requested on the standard State of North Carolina

Prequalification Form approved by the State Building Commission. Only pre-qualified contractors are allowed to bid to and contract with the CM on a project.

- b. All bids for Principal Trade and Specialty Contracts shall be publically advertised and shall be opened publically in a public venue, and once opened, shall be public records under N.C.G.S. 132. The CM shall award the contract to the lowest responsible, responsive bidder, taking into consideration quality, performance, the time specified in the bids for performance of the contract, the time for completion, compliance with N.C.G.S. 143-128.2, and other factors deemed appropriate by the Owner and advertised as part of the bid solicitation. When contracts are awarded pursuant to this section, the Owner shall provide for a dispute resolution procedure as provided by N.C.G.S. 143-128(f1). Once Principal Trade and Specialty Contractors are in place, the CM shall provide copies of the contracts to the Project Designer and also provide a list of equipment and material suppliers.
- c. A CM may perform a portion of the work only if (a) bidding produces no responsible, responsive bidder for that portion of the work, or (b) the lowest responsible, responsive bidder will not execute a contract for the bid portion of the work, or the Principal Trade or Specialty Contractor defaults and a prequalified replacement cannot be obtained in a timely manner, and (c) the Owner approves performance of the work by the CM.
- d. The Designer will furnish to any Principal Trade or Specialty Contractor, upon request, evidence regarding amounts of money paid to the CM on account of the work of the Principal Trade or Specialty Contractor.
- e. The CM is and remains fully responsible for his own acts or omissions as well as those of any Principal Trade or Specialty Contractor or of any employee of either. The CM agrees that no contractual relationship exists between the Principal Trade and Specialty Contractors and the Owner in regard to the contract, and that the Principal Trade and Specialty Contractors act on this work as an agent or employee of the CM.

ARTICLE 17 - CONSTRUCTION MANAGER AND SUBCONTRACTOR RELATIONSHIPS

The CM agrees that the terms of these contract documents shall apply equally to each Principal Trade and Specialty Contractor as to the CM, and the CM agrees to take such action as may be necessary to bind each Principal Trade and Specialty Contractor to these terms. The CM further agrees to conform to the Code of Ethical Conduct as adopted by the Associated General Contractors of America, Inc., with respect to CM-subcontractor relationships, and that payments to Principal Trade and Specialty Contractors shall be made in accordance with the provisions of N.C.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 N.C. G.S. 136-28.1, the balance due the CM 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 CM, 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. Should final

payment to the CM beyond the date such contracts have been certified to be completed by the Project Designer, 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 CM 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 the CM during construction shall be paid in accordance with the payment provisions of the contract documents or said CM 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 CM of each periodic or final payment, the CM shall pay the Principal Trade and Specialty Contractors based on work completed or service provided under their contract with the CM. Should any periodic or final payment to a Principal Trade or Specialty Contractor be delayed by more than seven days after receipt of periodic or final payment by the CM, the CM shall pay the Principal Trade or Specialty Contractor 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 CM to the Principal Trade and Specialty Contractors shall not exceed the percentage of retainage on payments made by the Owner to the CM. Any percentage of retainage on payments made by the CM to the Principal Trade or Specialty Contractors that exceeds the percentage of retainage on payments made by the Owner to the CM shall be subject to interest to be paid by the CM to the Principal Trade or Specialty Contractor at the rate of one percent (1%) per month or fraction thereof.
- d. Nothing in this section shall prevent the CM at the time of application and certification to the Owner from withholding application and certification to the Owner for payment to a Principal Trade or Specialty Contractor for unsatisfactory job progress; defective construction not remedied; disputed work; third-party claims filed or reasonable evidence that claim will be filed; failure of the Principal Trade or Specialty Contractor to make timely payments for labor, equipment and materials; damage to CM or another subcontractor; reasonable evidence that a Principal Trade or Specialty Contract 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 Project Designer shall provide liaison and necessary inspection of the work to ensure compliance with plans and specifications. He is the agent of the Owner only for the purpose of constructing this work and to the extent stipulated in the contract documents. He has authority to stop work or to order work removed, or to order corrections of faulty work where such action may be necessary to assure successful completion of the work.
- b. The Project 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 CM, taking sides with neither.

- c. Should the Project 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 Project Designer.
- d. The Project Designer will make periodic inspections of the project at intervals appropriate to the stage of construction. He will inspect the progress, the quality and the quantity of the work.
- e. The Project Designer and the Owner shall have access to the work whenever it is in preparation and progress during normal working hours. The CM shall provide facilities for such access so the Designer may perform his functions under the contract documents.
- f. Based on the Project Designer's inspections and evaluations of the project, the Project Designer shall issue interpretations, directives and decisions as may be necessary to assist the CM in the administration of the project. His decisions relating to artistic effect and technical matters shall be final, provided such decisions are within the limitations of the contract. The CM's decisions, however, relating to means and methods, and administration of the contracts the CM holds are final.

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

A field order, transmitted by fax 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.

The CM may be requested to make a change to the work by the Project Designer and Owner where such work is to be funded by the CM Contingency or Project Reserve that is part of the GMP contract. Such a change must be documented in the same manner as a Change Order and must be authorized in writing by the Project Designer and Owner by a Field Change document.

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

- c. In determining the values of changes, either additive or deductive, the CM and Principal Trade and Specialty Contractors are restricted to the use of the following methods:
 - 1. Where the extra work involved is covered by unit prices quoted in the proposal, the value of the change shall be computed by application of unit prices based on quantities,

estimated or actual as agreed of the items involved, except in such cases where a quantity exceeds the estimated quantity allowance in the contract by one hundred percent (100%) or more. In such cases, either party may elect to proceed under subparagraph c2 herein. If neither party elects to proceed under c2, then unit prices shall apply.

2. The contracting parties shall negotiate and agree upon the equitable value of the change prior to issuance of the change order, and the change order shall stipulate the corresponding lump sum adjustment to the contract price.
- d. Under Paragraph "b" and Methods "c(2)" above, the allowances for overhead and profit combined for a Principal Trade or Specialty Contractor and all multi-tier subcontractors shall not exceed fifteen percent (15%) of **net cost** of the work. No allowance for overhead and profit will be allowed for the CM until the change orders aggregate to a sum in excess of five percent (5%) of the Cost of the Work portion of the GMP. Once this threshold is met the CM may add an overhead & profit allowance not to exceed four percent (4%) of the net cost of the change order. Change orders to the GMP which authorize additional phases of a project without a change in scope of the originally intended project will not be considered in establishing the threshold for additional CM overhead & profit. Under Method "c (1)", no additional allowances shall be made for overhead and profit. In the case of deductible change orders, under Method "c(2)" and Paragraph (b) above, the contractor shall include no less than five percent (5%) profit, but no allowances for overhead.
- e. The term "net cost" as used herein shall mean the difference between all proper cost additions and deductions. The "cost" as used herein shall be limited to the following:
 1. The actual costs of materials and supplies incorporated or consumed as part of the project;
 2. The actual costs of labor expended on the project site;
 3. The actual costs of labor burden, limited to the costs of social security (FICA) and Medicare/Medicaid taxes; unemployment insurance costs; health/dental/vision insurance premiums; paid employee leave for holidays, vacation, sick leave, and/or petty leave, not to exceed a total of 30 days per year; retirement contributions; worker's compensation insurance premiums; and the costs of general liability insurance when premiums are computed based on payroll amounts; the total of which shall not exceed thirty percent (30%) of the actual costs of labor;
 4. The actual costs of rental for tools, excluding hand tools; equipment; machinery; and temporary facilities required for the project;
 5. The actual costs of premiums for bonds, insurance, permit fees and sales or use taxes related to the project.

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 breakdown showing method of arriving at net cost as defined above.

- g. In all change orders, the procedure will be for the Project Designer to request proposals for the change order work in writing. The CM will require the Principal Trade and Specialty Contractors to provide such proposals and supporting data in suitable format and will review and approve such change orders prior to submission to the designer. The Project Designer shall verify correctness. Within fourteen (14) days after receipt of the CM's proposal, the Project Designer shall prepare the change order and forward to the CM for his signature or otherwise respond, in writing, to the CM's proposal. Within seven (7) days after receipt of the change order executed by the CM, the Project Designer shall, certify the change order by his signature, and forward the change order and all supporting data to the Owner for the Owner's signature. The Owner shall execute the change order and forward to the State Construction Office for final approval, within seven (7) days of receipt. The State Construction Office shall act on the change order within seven (7) days. Upon approval by the State Construction Office, one copy remains with the State Construction Office, and the remaining copies are sent to the Project Designer for distribution to the Owner(s), CM and the surety. In case of emergency or extenuating circumstances, approval of changes may be obtained verbally by telephone or field orders approved by all parties, then shall be substantiated in writing as outlined under normal procedure.
- h. At the time of signing a change order, the CM shall be required to certify as follows:

"I certify that my bonding company will be notified forthwith that my contract has been changed by the amount of this change order, and that a copy of the approved change order will be mailed upon receipt by me to my surety."
- i. A change order, when issued, shall be full compensation, or credit, for the work included, omitted or substituted. It shall show on its face the adjustment in time for completion of the project as a result of the change in the work.
- j. If, during the progress of the work, the Owner requests a change order and the CM's terms are unacceptable, the Owner, with the approval of the State Construction Office, may require the CM to perform such work on a time and material basis in accordance with paragraph "b" above. Without prejudice, nothing in this paragraph shall preclude the Owner from performing or to have performed that portion of the work requested in the change order.

ARTICLE 20 - CLAIMS FOR EXTRA COST

- a. Should the CM consider that as a result of any instructions given in any form by the designer, he is entitled to extra cost above that stated in the contract, he shall give written notice thereof to the designer within seven (7) days without delay. 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 CM 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 will be considered unless the claim is so made. The Designer shall render a written decision within seven (7) days of receipt of claim.
- b. The CM shall not act on instructions received by him from persons other than the Project Designer, and any claims for extra compensation or extension of time on account of such instruction will not be honored. The Project Designer will not be responsible for misunderstandings claimed by the CM of verbal instructions which have not been confirmed in writing, and in no case shall instructions be interpreted as permitting a departure from the

contract documents unless such instruction is confirmed in writing and supported by a properly authorized change order.

- c. Should a claim for extra compensation that complies with the requirements of (a) above by the CM be denied by the Project Designer or Owner, and cannot be resolved by a representative of the State Construction Office, the CM may request a mediation in connection with N.C.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 CM is unable to resolve its claims as a result of mediation, then the CM may pursue his claim in accordance with the provisions of N.C.G.S. 143-135.3, or G.S. 143-135.6 where Community Colleges are the owner, and the following:
 1. A CM who has not completed a contract with a state agency or institution for construction or repair work and who has not received the amount he claims is due under the contract may submit a verified written claim to the Director of the State Construction Office of the Department of Administration for the amount the CM 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 N.C.G.S. Chapter 150B.
 2. (a) A CM who has completed a contract with a State agency or institution for construction or repair work and who has not received the amount he claims is due under the contract may submit a verified written claim to the Director of the State Construction Office of the Department of Administration for the amount the CM claims is due. The claim shall be submitted within sixty (60) days after the CM receives a final statement of the board's disposition of his claim and shall state the factual basis for the claim.
 - (b) The Director shall investigate a submitted claim within ninety (90) days of receiving the claim, or within any longer time period upon which the Director and the CM agree. The CM 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 CM a written statement of the Director's decision on the CM's claim.
 - (c) A CM 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 CM 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 Project Designer will have the authority to order minor changes in the work not involving an adjustment in the contract sum or time for completion, and not inconsistent with the intent of the contract documents. Such changes shall be effected by written order, copied to the State Construction Office, and shall be binding on the Owner and the CM.

ARTICLE 22 - UNCORRECTED FAULTY WORK

Should the correction of faulty or damaged work be considered inadvisable or inexpedient by the Owner and the Project Designer, the Owner shall be reimbursed by the CM. 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 final completion date will be as determined by the Owner, Designer and CM during the pre-construction phase of the project and will be incorporated into the contract for construction services between the Owner and the CM.
- b. The CM shall commence work to be performed under this agreement on a date to be specified in a written Notice to Proceed from the Project Designer and shall fully complete all work hereunder within the time of completion specified. For each day in excess of the above number of days, the CM 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 the CM to complete the work within the time specified, such time being in the essence of this contract and a material consideration thereof. Should the work be delayed by both the owner and contractor, liquidated damages shall be apportioned to reflect the delays of each party. In the case of concurrent delays, contractor caused delays shall be accounted for before owner and designer caused delays.
- c. If the CM is delayed at any time in the progress of his work by any act or negligence of the Owner or the Project Designer, or by any employee of either; by changes ordered in the work; by labor disputes at the project site; by abnormal weather conditions not reasonably anticipated for the locality where the work is performed; by unavoidable casualties; by any causes beyond the contractor's control; or by any other causes which the designer and Owner determine may justify the delay, then the contract time may be extended by change order for the time which the designer and Owner may determine is reasonable.

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

- d. Request for extension of time shall be made in writing to the designer, copies to the owner and SCO, within twenty (20) days following cause of delay. In case of continuing cause for delay, the CM shall notify the designer copies to the owner and SCO, of the delay within twenty (20) days of the beginning of the delay and only one claim is necessary.
- e. The CM shall notify his surety in writing of extension of time granted.
- f. No claim shall be allowed on account of failure of the Project 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 when the work is substantially complete.
- b. Should the owner request a utilization of a building or portion thereof, the designer shall perform a designer final inspection of area after being notified by the contractor that the area is ready for such. After the contractor has completed designer final inspection punch list and the designer has verified, then the designer shall schedule a beneficial occupancy inspection at a time and date acceptable to the owner, contractor(s) and State Construction Office. If beneficial occupancy is granted by the State Construction Office, in such areas the following will be established:
 - 1. The beginning of guarantees and warranties period for the equipment necessary to support. in the area.
 - 2. The owner assumes all responsibilities for utility costs for entire building.
 - 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 CM from any part of the project which the Project Designer has so certified to be substantially complete, but the Owner will allow the CM 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 CM 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 CM that the project is complete and ready for inspection, the Project Designer shall make a designer final inspection to verify that the project is complete and ready for SCO final inspection. Prior to SCO final inspection, the CM shall ensure that all items requiring corrective measures noted at the designer final inspection are complete.

The Project Designer shall schedule an SCO final inspection at a time and date acceptable to the Owner, the CM and the State Construction Office.

- b. At the SCO final inspection, the designer and his consultants shall, if job conditions warrant, record a list of items that are found to be incomplete or not in accordance with the contract documents. At the conclusion of the SCO final inspection, the designer and State Construction Office representative shall make the following determinations:
 - 1. That the project is completed and accepted.
 - 2. That the project is accepted subject to the correction of the list of discrepancies (punch list). All punch list items must be completed within thirty (30) days of SCO final inspection or the Owner may invoke Article 28, Owner's Right to Do Work.
 - 3. That the project is not complete and another date for a final inspection will be established.
- c. Within fourteen (14) days of acceptance per Paragraph c1 or within fourteen (14) days after completion of punch list per Paragraph c2 above, the Project 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 c1 or c2 above shall be handled in accordance with Article 42.
- e. The date of acceptance will establish the following:
 - 1. The beginning of guarantees and warranties period.
 - 2. The date on which the CM'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 CM (if applicable).
- f. **Prior to issuance of final acceptance date, the contractor shall have his authorized representatives visit the project and give full instructions to the designated personnel regarding operating, maintenance, care, and adjustment of all equipment and special construction elements. In addition, the contractor shall provide to the owner a complete instructional video (media format acceptable to the owner) on the operation, maintenance, care and adjustment of all equipment and special construction elements.**

ARTICLE 26 - CORRECTION OF WORK BEFORE FINAL PAYMENT

- a. Any work, materials, fabricated items or other parts of the work which have been condemned or declared not in accordance with the contract by the designer shall be promptly removed from the work site by the CM, and shall be immediately replaced by new work in accordance with the contract at no additional cost to the Owner. Work or property of the Owner, damaged or destroyed by virtue of such faulty work, shall be made good at the expense of the CM.
- b. Correction of condemned work described above shall commence within twenty-four (24) hours after receipt of notice from the Project Designer, and shall make satisfactory progress until completed.

- c. Should the CM 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 Project Designer, shall relieve the CM from responsibility for negligence, or faulty material or workmanship, or failure to comply with the drawings and specifications. The CM 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 CM and establish a time limit for completion of corrections by the CM. 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 CM 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 CM 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 CM, such action and cost of same having been first approved by the Project Designer. Should the cost of such action of the Owner exceed the amount due or to become due the CM, then the CM 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 CM fails to begin the work under the contract within the time specified or fails to establish a GMP or obtain bids from or enter into contracts with qualified Principal Trade or Specialty Contractors within the GMP, 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 CM 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 CM and his surety of such delay, neglect or default, specifying the same, and if the CM 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 CM, 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 CM 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 CM, then the said CM 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 CM and the surety shall be liable and shall pay to the Owner the amount of said excess.

ARTICLE 30 – CONSTRUCTION MANAGER’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 CM, 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 CM, 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 CM 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 CM 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 CM 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 CM's work has been satisfactorily completed on schedule, with approval of the owner and the State Construction Office and written consent of the surety, further requirements for retainage will be waived only so long as work continues to be completed satisfactorily and on schedule.
 4. Less previous payments.
 5. Current amount due.
- b. Prior to submitting the first payment request, the CM shall prepare a schedule showing a breakdown of the contract price into values of the various parts of the GMP contract. The Cost of the Work breakdown will be arranged so as to facilitate payments to the Principal Trade and Specialty Contractors in accordance with Article 17. The combined CM Construction Management Fee, Bonds & Insurance, CM Contingency, and Project Reserve (if any) will be shown on the Schedule of values as separate lines. The values for the CM Contingency and Project Reserve (if any) will move to appropriate lines within the Cost of the Work as those funds are committed and expended. This schedule of values will be submitted to & approved by the designer and Owner within 30 days of the Notice to Proceed.

The schedule of values shall be prepared in such form and supported by such data to substantiate its accuracy as the designer and Owner may require.

- c. Applications for payment shall be in a form agreed upon by the CM, designer and Owner and shall be prepared and supported by such data to substantiate the accuracy of the request as the designer may require.
- d. Subject to other provisions of the contract documents, the amount of each progress payment shall be computed as follows:
 - 1. Take that portion of the GMP properly allocable to completed work as determined by multiplying the percentage completion of each portion Cost of the Work by the share of the GMP allocated to that portion of the work in the schedule of values.
 - 2. Add that portion of the GMP properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the work or if approved in advance by the Owner, suitably stored off site at a location agreed upon in writing.
 - 3. Subtract the aggregate of previous payments made by the Owner.
 - 4. Subtract the amount, in any, by which the CM has been previously overpaid, as evidenced by the Owner's review of the CM's documentation.
 - 5. Subtract amounts, if any, for which the Project Designer has withheld or nullified a certificate of payment.
 - 6. Subtract retainage as per paragraph (h) below.
 - 7. Add the amount due for the CM Construction Management Fee calculated on the basis the percentage completion of the project or on a schedule of payment negotiated with the Owner less fifteen percent (15%) and less previous payments for CM Construction Management Fee.
- e. Payment allocated to Principal Trade and Specialty Contractors shall be subject to five percent (5%) retainage, provided, however that after fifty percent (50%) of the Cost of the Work has been satisfactorily completed on schedule, with the approval of the Owner and the State Construction Office and with 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. The balance of the CM Construction Management Fee shall be held by the Owner until satisfactory completion and close out of the project. Satisfactory completion and close out of the project means that the Owner and Project Designer are satisfied that the project has been completed in accordance with the plans and specifications and within the GMP, all general conditions of the contract pertaining to close out have been satisfied, and all Principal Trade and Specialty Contractors have satisfactorily completed their respective contracts. No retainage will be held for the cost of Bonds and Insurance
- f. 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 CM 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 CM, at his option, shall be permitted to store such materials and/or equipment in a suitable space off-site. Should the CM desire to include any such materials or equipment in his application for payment, they must be stored in the name of the owner in an independent, licensed, bonded warehouse approved by the designer, owner and the State Construction Office and located as close to the site as possible. The warehouse selected must be approved by the CM's bonding and insurance companies; the material to be paid for shall be assigned to the owner and shall be inspected by the designer. Upon approval by the designer, owner and SCO of the storage facilities and materials and equipment, payment therefore will be certified. Responsibility for such stored materials and equipment shall remain with the CM. Such stored materials and equipment shall not be moved except for transportation to the project site. Under certain conditions, the designer may approve storage of materials at the point of manufacture, which conditions shall be approved by the designer, the owner and the State Construction Office prior to approval for the storage and shall include an agreement by the storing party which unconditionally gives the State absolute right to possession of the materials at anytime. Bond, security and insurance protection shall continue to be the responsibility of the CM.

- g. In the event of beneficial occupancy, retainage of funds due the CM may be reduced with the approval of the State Construction Office to an equitable amount to cover the list of items to be completed or corrected. Retainage may not be reduced to less than two and one-half (2 1/2) times the estimated value of the work to be completed or corrected. Reduction of retainage must be with the consent and approval of the CM's bonding company.

ARTICLE 32 - CERTIFICATES OF PAYMENT AND FINAL PAYMENT

- a. Within five (5) days from receipt of request for payment from the CM, 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 CM 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 CM.
 - 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 CM 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 CM shall fully comply with all requirements specified in the "project closeout" section of the specifications. These requirements include but not limited to the following:
 - 1. Submittal of Product and Operating Manuals, Warranties and Bonds, Guarantees, Maintenance Agreements, As-Built Drawings, Certificates of Inspection or Approval

from agencies having jurisdiction. (The designer must approve the Manuals prior to delivery to the Owner).

2. Transfer of required attic stock material and all keys in an organized manner.
 3. Record of Owner's training.
 4. Resolution of any final inspection discrepancies.
 5. Granting access to Contractor's records, if Owner's internal auditors have made a request for such access pursuant to Article 52.
- e. The CM 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 contracts amounts and total actual payments to subcontractors and material suppliers.
 2. Affidavit of Release of Liens.
 3. Affidavit from CM 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 Project Designer, certificates of compliance issued, and the CM has complied with the closeout requirements. The designer shall forward the CM's final application for payment to the Owner along with respective certificate(s) of compliance required by law.

ARTICLE 33 - PAYMENTS WITHHELD

- a. The designer with the approval of the State Construction Office may withhold payment for the following reasons:
1. Faulty work not corrected.
 2. The unpaid balance on the contract is insufficient to complete the work in the judgment of the designer.
 3. To provide for sufficient contract balance to cover liquidated damages that will be assessed against the CM.
- b. The Secretary of the Department of Administration may authorize the withholding of payment for the following reasons:
1. Claims filed against the CM or evidence that a claim will be filed.
 2. Evidence that Principal Trade or Specialty Contractors have not been paid.

- c. The Owner may withhold all or a portion of CM's Project Management Fee costs set forth in the approved schedule of values, if CM has failed to comply with: (1) a request to access its records by Owner's internal auditors pursuant to Article 52; (2) a request for a plan of action and/or recovery schedule under Article 14.j or provide The Owner; (3) a request to provide an electronic copies of Contractor's baseline schedule, updates with all logic used to create the schedules in the original format of the scheduling software; and (4) Contractor's failure to have its Superintendent on the Project full-time.
- d. When grounds for withholding payments have been removed, payment will be released. Delay of payment due the CM without cause will make owner liable for payment of interest to the CM 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 CM has verified to the Owner that all required insurance and verifying certificates of insurance have been obtained and approved in writing by the Owner. These certificates shall contain a provision that coverage's afforded under the policies will not be cancelled, reduced in amount or coverage's eliminated until at least thirty (30) days after mailing written notice, by certified mail, return receipt requested, to the insured and the Owner of such alteration or cancellation.

a. Worker's Compensation and Employer's Liability

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

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

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 CM shall ensure that it and all Principal Trade and Specialty Contractors shall purchase and maintain property insurance during the life of this contract, upon the entire work at the

site to the full insurable value thereof. This insurance shall include the interests of the Owner, the CM, and subcontractors in the work and shall insure against the perils of fire, extended coverage, and vandalism and malicious mischief. If the Owner is damaged by failure of the CM to purchase or maintain such insurance, then the CM shall bear all reasonable costs properly attributable thereto; the CM 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 CM and/or the Principal Trade or Specialty Contractor as applicable.

e. Other Insurance

The CM shall ensure that it and all Principal Trade and Specialty Contractors 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 CM shall ensure that it and all Principal Trade and Specialty Contractors 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. The CM 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, which shall be in the amount of the GMP for the entire project. Bonds shall be executed in the form bound with the 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 CM on account of the contract shall not become due until the CM 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 to Principal Trade and Specialty Contractors in connection with his contract have been satisfied, and that no claims or liens exist against the CM in connection with this contract. In the event that the CM cannot obtain similar affidavits from the Principal Trade and Specialty Contractors to protect the CM and the Owner from possible liens or claims against the subcontractor, the CM shall state in his affidavit that no claims or liens exist against any subcontractor to the best of his (the CM's) knowledge, and if any appear afterward, the CM shall save the Owner harmless.

ARTICLE 37 - ASSIGNMENTS

The CM 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 CM under the contract may be assigned.

ARTICLE 38 - USE OF PREMISES

- a. The CM shall confine his apparatus, the storage of materials and the operations of his workmen to limits indicated by law, ordinances, permits or directions of the designer and shall not exceed those established limits in his operations.
- b. The CM shall not load or permit any part of the structure to be loaded with a weight that will endanger its safety.
- c. The CM 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 CM shall ensure that all cutting, fitting or patching that may be required to make the work 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 Principal Trade or Specialty Contractor shall endanger any work of another such contractor by cutting, digging or other means, nor shall he cut or alter the work of any other such contractor without the consent of the designer and the affected contractor(s).

ARTICLE 40 - UTILITIES, STRUCTURES, SIGNS

- a. The CM 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. If the Owner specifies that the CM is to pay all utilities, any permanent meters installed shall be listed in the CM's name until his work is fully accepted by the Owner. As stipulated in the Supplementary General Conditions, the Owner may: (1) pay utilities cost directly, (2) require the CM to pay all utilities cost, (3) or reimburse the CM for the actual cost of utilities. The Owner or CM, as applicable, may recover actual costs of metered utilities from the responsible party should delays occur in project completion. Coordination of the work of the utility companies during construction is the sole responsibility of the CM.
- b. If applicable Meters shall be relisted in the Owner's name on the day following completion and acceptance of the CM's work, and the Owner shall pay for services used after that date.
- c. Prior to the operation of permanent systems, the CM will provide temporary power, lighting, water, and heat to maintain space temperature above freezing, as required for construction operations.
- d. The CM shall ensure that the permanent building systems are 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 CM and the designer. Use of the equipment in this manner shall in no way affect the warranty requirements of the CM.

- e. The CM shall coordinate the work so that the building's permanent power wiring distribution system shall be in sufficient readiness to provide power as required by the HVAC contractor for temporary climatic control.
- f. The CM shall coordinate the work so that the building's permanent lighting system shall be ready at the time interior painting and finishing begins and shall provide adequate lighting in those areas where interior painting and finishing is being performed.
- g. The CM 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, the CM shall coordinate the removal and replacement of any parts of the permanent building systems damaged through use during construction.
 - 2. Temporary filters as recommended by the equipment manufacturer in order to keep the equipment and ductwork clean and free of dust and debris shall be installed in each of the heating and air conditioning units and at each return grille during construction. New filters shall be installed in each unit prior to the Owner's acceptance of the work.
 - 3. Extra effort shall be maintained to keep the building and the site adjacent to the building clean and under no circumstances shall air systems be operated if finishing and site work operations are creating dust in excess of what would be considered normal if the building were occupied.
 - 4. It shall be understood that any warranty on equipment presented to the Owner shall extend from the day of final acceptance by the Owner. The cost of warranting the equipment during operation in the finishing stages of construction shall be borne by the contractor whose system is utilized.
 - 5. The CM shall ensure that all lamps are in proper working condition at the time of final project acceptance.
- h. The CM shall provide, if required and where directed, a shed for toilet facilities and shall furnish and install in this shed all water closets required for a complete and adequate sanitary arrangement. These facilities will be available to other contractors on the job and shall be kept in a neat and sanitary condition at all times. Chemical toilets are acceptable.
- i. The CM shall, if required by the Supplementary General Conditions and where directed, erect a temporary field office, complete with lights, telephone, heat and air conditioning. A portion of this office shall be partitioned off, of sufficient size, for the use of a resident inspector, should the designer so direct.
- j. On multi-story construction projects, the CM shall either provide or ensure that temporary elevators, lifts, or other necessary special equipment is available for the general use of all contractors. The cost for such elevators, lifts or other special equipment and the operation thereof shall either be included in the CM Construction Management Fee or specified as part of the work of a Principal Trade or Specialty Contractor and paid for as a part of the Cost of the Work.

- k. The CM 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 CM's name, 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 CM shall ensure that the building and surrounding area is 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. The CM shall provide an on-site refuse container(s) for the use of all Principal Trade and Specialty Contractors. The CM shall ensure that each Principal Trade and Specialty Contractor removes their rubbish and debris from the building on a daily basis. The CM shall ensure that the building is broom cleaned as required to minimize dust and dirt accumulation.
- b. The CM shall provide and maintain suitable all-weather access to the building.
- c. Before final inspection and acceptance of the building, the CM shall ensure that all portions of the work are clean, 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 CM 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 CM 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 CM, 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 CM 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 CM, the CM's subcontractor, or the agents of either the CM or the CM'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 from Principal Trade and specialty Contractors and contract sum.
- e. Accounting Procedures for Refund of County Sales & Use Tax

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

CM's performing contracts for state agencies shall ensure that the Principal Trade and Specialty Contractors provide information to allow the CM to give the state agency for whose project the materials, supplies, fixtures and/or equipment was purchased a signed statement containing the information listed in N.C.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 contractors 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 CM.

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

ARTICLE 48 - ASBESTOS-CONTAINING MATERIALS (ACM)

The 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. Construction Managers are reminded of the requirements of instructions under 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

N.C.G.S. 143-128.2 establishes a ten percent (10%) goal for participation by minority businesses in total value of work for each State building project and requires documentation of good faith efforts for meeting that goal. The document, *Guidelines for Recruitment and Selection of Minority Businesses for Participation in State Construction Contracts* including Affidavits and Appendix F are hereby incorporated into and made a part of this contract.

The CM shall identify and define contract packages (the value of which shall total to at least ten percent (10%) of the GMP) that remove barriers to participation commonly experienced by Historically Underutilized Businesses and Minority Business Enterprises as those terms are defined in North Carolina General Statute 143-128.2, hereinafter referred to as Reduced Barrier Packages (RBP). Such contract packages will be submitted to the Owner for review. As an example, RBP's may require no performance or payment bond, or may offer the participation of the CM as a guarantor or surety in the financing of material purchases by the Principal Trade and/or Specialty Contractors, provided that the CM may condition such financing participation upon the

issuance of joint checks or other similar arrangements to allow the CM to verify that timely payments are made to suppliers furnishing credit. The CM may propose other and/or additional provisions for reducing barriers to participation.

The Owner shall require the CM to submit a plan for compliance with N.C.G.S.143-128.2 by approval by the Owner prior to soliciting bids for the Principal Trade and Specialty Contracts. The CM and Principal Trade and Specialty Contractors shall make a good faith effort to recruit and select minority businesses for participation in contracts pursuant to N.C.G.S. 143-128.2.

ARTICLE 50 – CONTRACTOR EVALUATION

The CM'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 compete for future capital improvement projects for institutions and agencies of the State of North Carolina. In addition to final evaluation, interim evaluation may be prepared during the progress of project. The document, Construction Manager Evaluation Procedures, is hereby incorporated and made a part of this contract. The Owner may request the CM's comments to evaluate the designer.

ARTICLE 51 – GIFTS

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

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

ARTICLE 52 – AUDITING-ACCESS TO PERSONS AND RECORDS

In accordance with N.C. General Statute 147-64.7, the State Auditor shall have access to Contractor's officers, employees, agents and/or other persons in control of and/or responsible for the Contractor's records that relate to this Contracts for purposes of conducting audits under the referenced statute. The Owner's internal auditors shall also have the right to access and copy the Contractor's records relating to the Contract and Project during the term of the Contract and within two years following the completion of the Project/close-out of the Contract to verify accounts, accuracy, information, calculations and/or data affecting and/or relating to Contractor's requests for payment, requests for change orders, change orders, claims for extra work, requests for time extensions and related claims for delay/extended general conditions costs, claims for lost productivity, claims for loss efficiency, claims for idle equipment or labor, claims for price/cost

escalation, pass-through claims of subcontractors and/or suppliers, and/or any other type of claim for payment or damages from Owner and/or its project representatives.

ARTICLE 53 – NORTH CAROLINA FALSE CLAIMS ACT

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

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

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

approval. (2) Knowingly makes, uses, or causes to be made or used, a false record or statement material to a false or fraudulent claim. (3) Conspires to commit a violation of subdivision (1), (2) ...” (Section 1-607(a)(1), (2).)

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

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

ARTICLE 54 – TERMINATION FOR CONVENIENCE

- a. Owner may at any time and for any reason terminate CM’s services and work at Owner's convenience. Upon receipt of such notice, CM shall, unless the notice directs otherwise, immediately discontinue the work and placing of orders for materials, facilities and supplies in connection with the performance of this Agreement.
- b. Upon such termination, CM 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 CM as are permitted by the prime contract and approved by Owner; (3) plus ten percent (10%) of the cost of the work referred to in subparagraph (1) above for overhead and profit. There shall be deducted from such sums as provided in this subparagraph the amount of any payments made to CM prior to the date of the termination of this Agreement. CM shall not be entitled to any claim or claim of lien against Owner for any additional compensation or damages in the event of such termination and payment.

**SUPPLEMENTARY GENERAL CONDITIONS
(SGC's) OF THE CONTRACT**

**STANDARD FORM FOR CONSTRUCTION
CONTRACTS**

**NORTH CAROLINA STATE
UNIVERSITY**

NC State University Design and Construction Guidelines

Supplementary General Conditions

SUPPLEMENTARY GENERAL CONDITIONS (SGC's) OF THE CONTRACT

The use or reproduction of this document or any part thereof is authorized for and limited to use on projects of North Carolina State University, and is distributed by, through and at the discretion of the University for that distinct and sole purpose. This document supplements but does not alter in any way the requirements of the General Conditions of the Contract.

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1.0 SGC Article 1 – Definitions

- A. As defined in Article 1 of the General Conditions, the Supplementary General Conditions are considered part of the contract documents.
- B. The Owner is the State of North Carolina through North Carolina State University.
- C. Provide shall mean purchase, deliver, and install, new, clean, and completely operational, fully tested and ready for use.

2.0 SGC Article 14 – Construction Supervision and Schedule

- A. 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 benchmark nearby in a location where same will not be disturbed and where direct instruments sights may be taken.
- B. The designer shall designate a Project Expediter on projects involving two or more prime contracts. The Project Expediter shall be the General Contractor unless determined otherwise by the designer. The Project Expediter shall have the responsibilities described in Article 14.f. of the General Conditions.
- C. Project Construction Schedule. North Carolina State University requires a CPM schedule for all projects, regardless of size and/or dollar amount. Bar Chart schedules may be allowed on a case-by-case basis. All CPM schedules shall meet the requirements of the General Conditions as well as the following:
 - 1. The CPM Baseline Schedule or Updated Schedule shall consist of the computer files on electronic media necessary to recreate the schedule. Files shall consist of four discrete items:
 - a) The Activity description including the original and remaining durations, and percent complete. Show other computed information such as early and late computed start and finish times and various types of floats.
 - b) The logical predecessor and successor relationships that connect the various activities together to form a CPM network. All activities shall be linked with no

NC State University Design and Construction Guidelines

Supplementary General Conditions

constraints placed on any activity unless critical milestone dates are dictated in the contract.

- c) Constraints listing if any must exist.
 - d) All hidden codes or constraints assigned to activities by the Scheduler, which help define the intended workflow or project organization.
2. Each schedule submittal shall include a cover letter, a narrative, a hard copy of the schedule and the schedule files on electronic media. The schedule update narrative should state what activity changes happened on the project, including missing data, upcoming changes, documented delays, potential delays and other facts.
 3. Contractors and subcontractors shall include a minimum of five (5) full days in their base bid for their project superintendent and project manager to attend a preliminary scheduling meeting with the project expediter. Each contractor shall attend additional scheduling meetings as required until an acceptable construction schedule conforming to the contract time is completed and approved via signing of the printed schedule by the single or each prime contractor (project manager and superintendent). Copies of the signed schedule shall be given to the Designer, Owner and each signatory; the original shall be displayed at the jobsite. The submitted schedule shall show the contract project completion date.
 4. The schedule shall be updated monthly or at the Designer and/or Owner's request. The project expediter shall make all updates, adjustments, corrections, etc., with input provided from the other prime or subcontractors. It will be the responsibility of each prime and/or subcontractor to either agree or disagree with the updated schedule via signing and dating the schedule submitted by the project expediter or providing a written summary of schedule exceptions and/or inaccuracies.
 5. Project expediter is required to provide an updated construction schedule with each monthly payment application. It will be the responsibility of each prime and/or subcontractor to either agree or disagree with the updated schedule via signing and dating the schedule submitted by the project expediter or providing a written summary of schedule exceptions and/or inaccuracies. Payment requests received without one or the other of the above will be considered incomplete and will be returned as being incomplete. The only contractor required to submit a copy of the updated progress schedule with his monthly payment application is the project expediter.
 6. A completion or finish schedule is required at 80% project completion, illustrating tasks remaining to complete the project. The designer and Owner are required to approve finish schedule.
 7. Project expediter shall include all relevant testing and inspections on the CPM schedule, including but not limited to: telecom/data wiring tests and as-built drawings, fire alarm system testing, fire suppression system testing, piping pressure testing, all applicable NFPA, DOI, DOL tests and commissioning activities.
 8. The Contractor will schedule as Milestones in the CPM schedule and ensure they are met the following activities: MEPFP Coordination drawings, Casework and Fume Hood Submittals and shop drawings shall be submitted to the design team for review NO LATER than 30 days after the Notice To Proceed.

NC State University Design and Construction Guidelines

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3.0 SGC Article 23 - Time Of Completion, Delays, Extension of Time

- A. For each day in excess of the number of days shown below, the contractor(s) shall pay the owner liquidated damages in the amount of \$_____ per consecutive calendar day. [Designer and Owner to jointly determine amount of LD's based on specific project requirements.]

☐

This project does not include Commissioning

- B. The time of completion for this project is _____ consecutive calendar days and begins on the date stated in the Designer's Notice to Proceed letter issued to the contractor.

☐

This project includes Commissioning

- B. The time of completion to SUBSTANTIAL COMPLETION for this project is _____ consecutive calendar days and begins on the date stated in the Designer's Notice to Proceed letter issued to the contractor. SUBSTANTIAL COMPLETION for this project is defined as the General Contractor and its subcontractors having completed the following:

1. GC's Pre-Final Punch List
2. Testing Adjusting and Balancing (TAB) is complete per the project specifications.
3. Pre-Functional Testing shall be complete and the completed report shall be issued to the design team prior to SUBSTANTIAL COMPLETION.

For a period not to exceed _____ weeks following immediately after SUBSTANTIAL COMPLETION, the Owner's agents will perform Enhanced Start UP of MEP systems and punch list generation and back punch activities. The contractor will be responsible for assisting in all testing and punch activities including the completion of all adjusting, balancing, repairing, correcting, replacing and completing unacceptable or otherwise incomplete work identified by the design team.

NC State University Design and Construction Guidelines

Supplementary General Conditions

4.0 SGC Article 40 – Utilities, Structures, Signs

- A. UTILITIES FOR NEW BUILDINGS - The Project Expediter will make arrangements with the appropriate utility service providers to provide temporary utilities to the site. The Project Expediter shall bear the costs of providing all temporary utilities to the site and all charges for temporary utilities during the project duration.
- B. UTILITIES FOR EXISTING BUILDINGS – The Project Expediter will make arrangements with either the appropriate utility service providers or with NCSU (if the existing building is already metered) to provide temporary utilities to the site. The University will bear the cost of all temporary utilities except the use of supplemental generators for power. The contractor may use what is available on site without affecting the ongoing operations of the Owner in any way, but may not request additional services that are not already present. Anything additional required by the contractor will be procured and paid for by the contractor

Electricity: \$_____/KWH (kilo-watt hour)

Water: \$_____/CCS (hundred cubic feet)

Steam: \$_____/thousand pounds

Natural gas: \$_____/deca-therm

SECTION 011000 – SUMMARY

PART 1 – GENERAL

1.1. SUMMARY

A. Section Includes:

1. Project Information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Codes and Standards.
5. Specification and drawing conventions.
6. Miscellaneous provisions.

1.2. RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to the Work of all Sections in the Specifications. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all.
- B. Conflicts or discrepancies among the Contract Documents shall be resolved in the following order of priority:
 1. The Form of Contract, as modified by Contract modifications (Change Orders). Change Orders of later date take precedence over those instruments of earlier date;
 2. The General Conditions, as modified by the Supplementary General Conditions;
 3. Specifications;
 - a. Specifications govern Drawings for quality and performance.
 4. Drawings.
 - a. Drawings govern Specifications for quantity and location.
 - b. In the event of a conflict between small-scale detail drawings (e.g. less detailed, 1/8"=1'-0" scale) and large-scale detail drawings (e.g. more detailed, 1-1/2" = 1'-0" scale), the largest scaled drawings take precedence.
- C. In the event of ambiguity or conflicts between Specifications and Drawings, the greater quantity and the better quality shall govern.

1.3. PROJECT INFORMATION

- A. Project Identification: NCSU Textiles Complex – Flex Factory Renovations.
 1. Project Location: 1020 Main Campus Dr., Raleigh, NC 27606
- B. Project Directory: Refer to Specification Section 000103 "Project Directory".
- C. Project Web Site: A Project Web Site administered by Contractor will be used for purposes of managing communication and documents during the construction stage.

1. See Section 013100 "Project Management and Coordination" for requirements for establishing, administering, and using the Project Web Site.

1.4. WORK COVERED BY CONTRACT DOCUMENTS

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

1. Work includes the partial renovation of the Wilson College of Textiles, an existing office, classroom and lab building, on the Centennial Campus of North Carolina State University, and other work indicated in the Contract Documents. The building construction is Type I-B, Occupancy Group B. The work includes interior demolition, new interior storefront, new interior finishes, new light fixtures and upgraded mechanical and electrical systems throughout the work area.

- B. Type of Contract: CM-at-Risk

1.5. PHASED CONSTRUCTION

- A. The Work shall be conducted in two (2) phases, with each phase substantially complete as indicated.

1. Phase One: Renovation work in Prototype Lab (1103) and Production Lab (1103B).
 - a. Notice to Proceed: Work of this phase shall commence with the Notice to Proceed.
 - b. Substantial Completion: Work of this phase shall be substantially complete by December 19, 2025.
2. Phase Two: Renovation work in Senior Design Studio (1202) and Innovation Lab (1210A).
 - a. Notice to Proceed: Work of this phase shall commence on Notice to Proceed.
 - b. Substantial Completion: Work of this phase shall be substantially complete by July 17, 2026.

1.6. CODES AND STANDARDS

- A. All references to codes, specifications and standards referred to in the Contract Documents shall mean, and are intended to be, the edition referenced in the Appendix B as noted in the Project Drawings.

- B. In addition to the codes, specifications and standards referred to in the Contract Documents all work provided under this Contract shall comply with the applicable provisions of the following, where standards conflict the more stringent shall apply:

1. Electrical Utility: **Duke Energy**
2. Gas Utility: **Dominion Energy**
3. Water Utility: **City of Raleigh**
4. Sewer: **City of Raleigh**
5. Stormwater: **City of Raleigh**
6. Zoning: **City of Raleigh**

1.7. SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.
 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.
- 1.8. MISCELLANEOUS PROVISIONS
- A. Special Insurance: Contractor's Commercial General Liability insurance shall contain no exclusion that would deny coverage for any claim arising out of or contributed to by any fungus, mildew, mold, or resulting allergens. If such exclusion exists and cannot be removed by endorsement, Contractor shall submit proof of coverage for fungus, mildew, mold, or resulting allergens under a Pollution Legal Liability or Contractor's Pollution Liability policy.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000



SECTION 011116 – WORK BY OWNER

PART 1 – GENERAL

1.1. SUMMARY

A. Section Includes:

1. Owner Furnished equipment for Contractor Installation (OFCI).
2. Owner Furnished and Owner Installed equipment (OFOI).
3. Owner performed work.

1.2. 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.

1.3. INSURANCE AND SAFETY

- ##### A. Work performed by Owner and/or Owner's Contractors must abide by the Contractor's insurance and safety requirements. Owner and Contractor shall coordinate logistics and schedule to ensure the safe installation of OFOI work.

PART 2 – PRODUCTS

2.1. OWNER FURNISHED EQUIPMENT FOR CONTRACTOR INSTALLATION

- ##### A. Owner will furnish products indicated.

B. Owner-Furnished Products:

1. Blowers for textile equipment.

C. Division 06 – Miscellaneous Carpentry

1. All blocking to support the OFCI equipment listed herein is by the Contractor.

2.2. OWNER FURNISHED AND OWNER INSTALLED EQUIPMENT

A. Owner-Furnished, Owner-Installed Products:

1. Mini refrigerators.
2. Refrigerator.
3. Microwave ovens.
4. A/V equipment.
5. Furniture.
6. High-density shelving system.
7. All textile fabrication/production/design equipment, unless noted otherwise.
8. Security equipment.
9. Signage, as noted in drawings.
10. Shelving, as noted in drawings.



PART 3 - EXECUTION

3.1. OWNER PERFORMED WORK

A. Division 01 – General Requirements

1. All existing valves and circuits must be operated by NC State personnel.

B. Division 02 – Demolition

1. Owner to coordinate with NCSU Waste Reduction and Recycling on salvage and recycling of identified equipment, furniture, and materials prior to demolition.

C. Division 08 – Door Hardware

1. Owner to be responsible for coordinating keying of hardware with University Lock Shop and Security.

D. Division 27 – Telecommunications

1. Owner to be responsible for providing cable/wire through pathways provided by contractor.
2. Owner to be responsible for connecting equipment, at locations provided by contractor, to power and data, and tying into existing University systems.

E. Division 27 – Audiovisual

1. Owner to be responsible for providing cable/wire through pathways provided by contractor.
2. Owner to be responsible for connecting equipment, at locations provided by contractor, to power and data, and tying into existing University systems.

F. Division 28 – Security & Access Control

1. Owner to be responsible for providing cable/wire through pathways provided by contractor.
2. Owner to be responsible for connecting equipment, at locations provided by contractor, to power and data, and tying into existing University systems.

END OF SECTION 011000

SECTION 011400 – WORK RESTRICTIONS

PART 1 – GENERAL

1.1. SUMMARY

A. This Section Includes:

1. Owner's Representative.
2. Employee Screening.
3. Behavior Policy.
4. Working Hours.
5. Use of Premises.
6. Utility Interruptions.
7. Fire Alarm Shutdowns.
8. Hot Work Permits.
9. Coordination with Occupants.
10. Miscellaneous restrictions.

B. Related Sections include the following:

1. Section 006000 "Project Forms" for the Outage Request Form and Method of Procedure Form to be submitted by the Contractor when requesting Utility Interruptions.
2. Section 015500 "Vehicular Access & Parking" for additional requirements on access and parking.

1.2. 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.

1.3. OWNER'S REPRESENTATIVE

- A. NC State has designated a Project Manager to act as the Owner's Representative in all matters pertaining to construction contracts. All official contacts, decisions, directions, problem resolution, coordination and other liaison activities required from NC State will be through the Project Manager. This requirement does not modify the responsibilities of the Designer as stated in the General Conditions of the Contract. The Project Manager for this project is listed in the Project Directory.

1.4. EMPLOYEE SCREENING

- A. Contractor, at its expense, shall conduct a background check for each of its employees, as well as for the employees of its subcontractors, who will perform any function or activity under this Agreement. NC State may withhold consent for any of Contractor's employees to be placed on a NC State assignment at its sole discretion.
1. Maintain list of approved screened personnel with Owner's representative.

1.5. BEHAVIOR POLICY

- A. All construction personnel shall be respectful of all members of the NC State community.

- B. 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 NC State community is strictly prohibited. Any such act shall constitute sufficient cause for NC State to remove any individual permanently from the project and all NC State property.
- C. Any of the Contractor(s) project personnel who ignore or refuse to take action on any requirements of the contract documents or ignore or refuse to take immediate action to correct any endangerment to the health and safety of the public (as solely determined by NC State) shall be permanently removed from the project and NC State property.
- D. If in the sole determination of NC State, it is in the best interest of the project and NC State to have any of the Contractor(s) personnel removed from the project, then the Contractor shall do so upon request by NC State. Such actions taken by NC State shall not constitute grounds for a delay claim. NC State will not be responsible for any delays caused to the project due to any individual being removed from the project by NC State.

1.6. WORKING HOURS

- A. The Contractor shall assume typical working hours of 7:00 AM to 5:00 PM, Monday through Friday. Work outside of these typical hours should be coordinated with NC State's Project Manager at least fourteen (14) calendar days in advance, or as further defined in the CM bid package. The Contractor shall submit to NC State and to the Designer his regular daily work schedule and shall notify NC State in writing one week in advance of any deviations from the schedule.
- B. NC State reserves the right to limit the Contractor's activities when they conflict with NC State operations at no additional cost or delay to the project. During times in which construction operations conflict with NC State operation, NC State may require the Contractor to cease all construction activities, limit activities to on-site only, modify working hours, make accommodations for access, restrict noise-making activities, or other limitations as determined by NC State. Instances in which construction operations may conflict with NC State operations include, but are not limited to, the following:
 - 1. Study and Examination periods;
 - 2. Graduation;
 - 3. Athletic or Special events;
 - 4. Student move in/move out days;
 - 5. University Holidays.

1.7. USE OF PREMISES

- A. Parking & Staging Areas
 - 1. Parking is extremely limited at NC State. Parking for personal vehicles on campus is not provided by NC State and is the responsibility of the Contractor. Contractors must limit parking of company vehicles and storage of materials to within the limits of the construction site and staging area.
 - 2. The Contractor is required to follow NC State Transportation's Contractor Parking Policies as described online at: <https://transportation.ncsu.edu/construction-parking-information/>
 - 3. Reserved Spaces & Staging Areas must be approved in advance by NC State's Project Manager and NC State Transportation. A current logistics plan must be

submitted by the Contractor to NC State in order for any reserved spaces or staging areas to be approved.

B. Traffic Movement & Interruptions

1. The Contractor shall make requests for approval for any street, alley, driveway or any access way to be closed at least fifteen (15) workdays prior to the date for the desired closing.
 - a. The request shall be accompanied by a proposed traffic control plan prepared by the Contractor detailing all signage and detour routes in accordance with MUTCD current revision requirements.
 - b. The plan must be reviewed and approved by Designer and NC State.
2. The Contractor shall close no street, alley, driveway or access-way without prior approval by NC State. Contractor shall only install a blockage after NC State has provided written approval of the proposed blockage.
 - a. All blockages and detours shall be planned, subject to approval by NC State, considering handicapped access.
3. The Contractor shall install warning signs, barricades, and detour information signs to maintain traffic flow as directed by NC State, and in accordance with MUTCD requirements. If required, flagmen provided by the Contractor shall direct traffic around the construction area or detour area.
 - a. At all times, pedestrian and vehicle traffic wayfinding around the construction limits must be maintained in a clean and safe condition.
4. NC State is a handicap accessible campus. All barricades, temporary walkways, excavations, and stockpiled materials shall be placed and/or constructed in such a manner as to accommodate, adequately warn, and protect all members of the campus community, as well as the general public. Contractor shall not block accessible pathways without providing suitable alternative accessible pathways as agreed upon by Designer and NC State. Owner reserves the right to reject or modify Contractor's Site Logistics Plan as necessary to ensure handicap accessibility throughout campus.
5. No excavations shall take place prior to placing proper barricades, lighting, and other devices as shall be required.

1.8. UTILITY INTERRUPTIONS

- A. The Contractor shall ensure all campus utilities and other campus services are maintained throughout the Project, except for scheduled interruptions.
- B. The Contractor shall submit an Outage Request to NC State's Project Manager at least fourteen (14) calendar days in advance for minor outages and thirty (30) calendar days in advance for major outages. While the Outage Request Form provided in Section 006000 "Project Forms" lists shorter durations, the durations listed herein are required so all communication, collaboration, and coordination can occur to ensure a successful Outage.
 1. No utility interruption, regardless of the advance notice given, shall be undertaken without written approval from NC State.

2. All Outage Requests for a utility interruption must include an Outage Request Form and a Method of Procedure (MOP) describing the sequence of operations for the work to be performed by the Contractor during the outage. Incomplete Outage Requests will not be processed.
3. Upon receipt of the Outage Request Form and MOP, NC State will notify the Contractor that the Contractor can schedule a coordination meeting with NC State's Project Manager and appropriate personnel from the NC State Zone Shop or Department, and other interested parties, to discuss the Outage Request and the MOP.
 - a. No outage will be scheduled without a coordination meeting.
4. NC State may determine the utility service cannot be interrupted for the length of time or frequency requested by the Contractor.
5. NC State will determine if an outage is considered major or minor.
6. Examples of major outages include, but are not limited to, outages impacting:
 - a. An entire building;
 - b. An entire floor of a building;
 - c. All or parts of several buildings;
 - d. All or parts of an area;
 - e. Any high voltage outage.
- C. If requested by NC State, utility outages shall be performed after hours and/or at night, or over the weekend, or during holidays. No extra payment will be made for such work.
- D. Certain activities of utility outages must be performed by NC State and cannot be performed by the Contractor. Examples of activities to be performed by NC State include, but are not limited to:
 1. Operating existing electrical switches;
 2. Turning existing water, chilled water, and steam valves;
 3. Placing existing building systems back in operation;
 4. Operating existing fire alarm systems.
- E. While NC State will provide reasonable support to the Project at no cost to the Contractor, when the Contractor requires an additional or extra outage to complete their work because of a shortage of or improper materials, shortage of labor, poor coordination, failure to finish the work during the outage scheduled length of time, the Contractor will pay all expenses incurred for NC State's services for an additional outage(s) via deductive Change Order.
- F. Signs and barricades (if applicable) for utility outage notice shall be written and placed as directed by NC State seven (7) workdays prior to the outage. No outage shall take place until signs and barricades (if applicable) are in place to notify and/or protect the public. Signs and barricades (if applicable) must be maintained throughout the outage.
 1. Signs shall be neat and legible, hand-made signs are not acceptable.
- G. The Contractor shall include in his base bid provisions for temporary utility equipment and services for the duration of the outage(s) required to complete the Project.

1.9. FIRE ALARM SHUTDOWNS

- A. The Contractor shall schedule all fire alarm shutdowns to support the Project with NC State's Project Manager at least five (5) workdays in advance. Fire Alarm shutdowns must be conducted by NC State.
- B. If at any time the fire alarm system is not in operation after normal working hours then the Contractor shall be required to employ a Fire Watch for the unprotected portion of the building, using a Fire Watch company approved by NC State's Fire Marshal.

1.10. HOT WORK PERMITS

- A. 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 NC State Environmental Health and Public Safety, Fire Protection Department. The department's requirements for the hot work program and permit can be found at the web link on the first page of this document. The EH&PS Hot Work Policy (rev. May 1, 2022) is appended to the end of this section.
- B. <https://fls.epsi.ncsu.edu/forms/hot-work-permit-request/>

1.11. COORDINATION WITH OCCUPANTS

- A. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts, including noise disturbance, and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits unless otherwise indicated.
- B. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
- C. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.
- D. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Final Acceptance of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.
- E. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.
- F. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.
- G. Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.
- H. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.



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1.12. MISCELLANEOUS RESTRICTIONS

A. Controlled Substances: Use of tobacco products and other controlled substances on NC State's campus is not permitted.

1. Exception: Controlled substances as prescribed by a doctor are allowable provided appropriate documentation that does not violate HIPPA requirements is available.

B. Firearms are prohibited on all university property.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011400

SECTION 012200 - UNIT PRICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for unit prices.
- B. Related Sections include the following:
 - 1. Section 012100 "Quantity Allowances" for procedures for using unit prices to adjust quantity allowances.
 - 2. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.

1.2 RELATED DOCUMENTS

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

1.3 DEFINITIONS

- A. Unit price is an amount incorporated in the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of the Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROCEDURES

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

1.1 SCHEDULE OF UNIT PRICES

- A. Unit Price No. E1: New photoelectric smoke detector

1. Purpose: To adjust the contract sum in case a quantity different from that indicated in the contract documents is required.
 2. Unit of Measurement: each.
 3. Include the following in the unit price:
 - a. 50 linear feet of wiring and conduit, new surface mounted box, and programming.
 - b. Overhead and profit.
 4. Include all other related costs in the contract sum.
- B. Unit Price No. E2: New emergency light.
1. Purpose: To adjust the contract sum in case a quantity different from that indicated in the contract documents is required.
 2. Unit of Measurement: each.
 3. Include the following in the unit price:
 - a. 50 linear feet of wiring and conduit, new surface mounted box, and programming.
 - b. Overhead and profit.
 4. Include all other related costs in the contract sum.
- C. Unit Price No. E3: New exit sign.
1. Purpose: To adjust the contract sum in case a quantity different from that indicated in the contract documents is required.
 2. Unit of Measurement: each.
 3. Include the following in the unit price:
 - a. 50 linear feet of wiring and conduit, new surface mounted box, and programming.
 - b. Overhead and profit.
 4. Include all other related costs in the contract sum.
- D. Unit Price No. E4: New Fire Alarm Horn/Strobe (75 candela).
1. Purpose: To adjust the contract sum in case a quantity different from that indicated in the contract documents is required.
 2. Unit of Measurement: each.
 3. Include the following in the unit price:
 - a. 50 linear feet of wiring and conduit, new surface mounted box, and programming.
 - b. Overhead and profit.
 4. Include all other related costs in the contract sum.
- E. Unit Price No. FP1: New sprinkler head.
1. Purpose: To adjust the contract sum in case a quantity different from that indicated in the contract documents is required.
 2. Unit of Measurement: each.
 3. Include the following in the unit price:
 - a. 30 linear feet of piping.
 - b. Overhead and profit.
 4. Include all other related costs in the contract sum.

- F. Unit Price No. A1: Trowelable Patching Compound for concealed slabs.
1. Purpose: To adjust the contract sum in case a quantity different from that indicated in the contract documents is required.
 2. Unit of Measurement: square foot.
 3. Include the following in the unit price:
 - a. Labor and materials to install 1 SF of trowelable leveling compound.
 - b. Slab preparation required to install 1 SF of trowelable leveling compound.
 - c. Overhead and profit.
 4. Include 100 SF of trowelable patching compound in the contract sum.
 5. Include all other related costs in the contract sum.

END OF SECTION 012200

SECTION 012200 – ALTERNATES

PART 1 – GENERAL

1.1. SUMMARY

- A. Section includes administrative and procedural requirements for alternates.
- B. Related Sections include the following:
 - 1. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.

1.2. 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.

1.3. DEFINITIONS

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

1.4. PROCEDURES

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

PART 2 - PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1. SCHEDULE OF ALTERNATES**A. Alternate No. G-01: Folding Glass Doors**

1. Base Bid: Existing overhead coiling doors to remain.
2. Alternate Bid: Bids to provide add pricing for folding glass doors in existing coiling door openings, including:
 - Two new folding glass doors, scheduled as 1103A and 1210AA.
 - New structural steel opening framing.
 - Installation.
 - Removal of existing coiling door, motors, and associated components.

B. Alternate No. G-02: Finishes

1. Base Bid: No homasote panels in Senior Design Studio (1202); existing slabs to be cleaned and sealed, no staining; exposed ceiling structure and systems in Senior Design (1202) and Innovation Lab (1210A) to be unpainted.
2. Alternate Bid: Bids to provide add pricing for the following finish upgrades, itemized as follows:
 - 2A. New homasote wall panels in the Senior Design Studio (1202) and blocking as required.
 - 2B. Concrete floor stains F02 and F03 with sealant and saw cutting of slab.
 - 2C. Painting of exposed ceiling structure and systems in Senior Design (1202) and Innovation Lab (1210A).

C. Alternate No. G-03: Secure Workspace Millwork

1. Base Bid: No cabinets in Secure Workspaces (1204, 1206, 1208). Painted GWB wall finish, typical.
2. Alternate Bid: Bids to provide add pricing for base cabinets in the Secure Workspaces (1204, 1206, 1208), including:
 - New open base cabinets with solid surface countertops.

3.2. SCHEDULE OF PREFERRED BRAND ALTERNATES**A. Preferred Brand Alternate No. G-04: Electrified Door Hardware – reference NCSU Security Applications and Technologies guidelines. Provide the following as indicated:**

1. Electrified Mortise Locksets – Schlage L9092EU; Best 45HW7DEU
2. Electrified Access Control Exit Device – Von Duprin 98/99/33 Series QEL, LX/RX
3. Wireless Access Control Locksets – Schlage LE Greenwich/DPS or AD-400/DPS
4. Door Hardware Power Supplies – Altronix AL600ULACMCB with Access Module (Field Application); Altronix Maximal 33 (Security Headend Application) or LifeSafety Power NetLink Integration with C-CURE 9000 (Security Headend Application)
5. Electro-mech Transfer Plate Hinge – Stanley, Command Access, or Hager
6. Electric Power Transfer Hinge – Von Duprin EPT-10

B. Preferred Alternate No. G-05 Mechanical Door Hardware – reference NCSU Building Services guidelines. Provide the following as indicated:

1. Mortise locks, key-in lever, cylindrical deadbolts – Best 45H Series; Schlage L9000 Series
2. Manual door closers, swing doors – LCN 4040, 4111, 4110
3. Panic hardware and strikes – Von Duprin 98/99 rim and vertical rod devices
4. Cores – Schlage, Best (small format interchangeable core 7-pin only)
5. Continuous hinges – Ives, Select Hager

- C. Preferred Alternate No. H-01 HVAC Control: Alternate shall consist of all work associated with the installation of a Schneider Electric Invensys HVAC. Reference documents Specification Section 230900 and NCSU Energy Management Guidelines.
- D. Preferred Alternate No. H-02 HVAC Control: Alternate shall consist of all work associated with the installation of a Johnson Controls Metasys controls system. Reference documents Specification Section 230900 and NCSU Energy Management Guidelines.

END OF SECTION 012300

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Sections:
 - 1. Section 006000 "Project Forms" for the Substitution Request Form.
 - 2. Section 007200 "General Requirements" for requirements on when Substitutions are allowable.
 - 3. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.
 - 4. Section 013300 "Submittal Procedures" for administrative requirements for submittals.
 - 5. Divisions 02 through 49 Sections for specific requirements and limitations for substitutions.

1.2 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. Requests for substitution of materials, items, or equipment shall be submitted to the Project Designer for approval or disapproval; such approval or disapproval shall be made by the designer prior to the opening of bids. Substitutions after bidding are only allowed if it can clearly be demonstrated that the substitution is for the sole benefit of the Owner, and the Designer and Owner approve of the substitution.

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, as limited to the following conditions:
 - a. Unavailability of product within the Contract Duration;
 - b. Regulatory or significant manufacturing changes that prevent the manufacture or delivery the product;
 - c. Net savings to the project, either in Contract Duration or Project Cost. If there is a time savings, the Contractor must also return to Owner the corresponding savings to General Conditions. Contractor is responsible for Designers time to detail the substitution, which may negate Contractors proposed savings and be a net addition to the project cost, in which case the substitution would not be allowable.
 - 2. Substitutions for Convenience: All other changes proposed by Contractor. Substitutions for convenience are not allowed.

1.4 ACTION SUBMITTALS

- A. Substitution Requests: Identify product or fabrication or installation method to be

replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution requests must be submitted by the Contractor in a timely manner so the request can be reasonably evaluated so as not to impact the Project Schedule. Delays resulting from the Substitution Request process shall not relieve the Contractor from its obligation to complete the project within the duration specified in the Contract Documents.
2. Substitution Request Form: Use "Substitution Request" form provided in Section 006000 "Forms."
3. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Provide Contractor Name, address, and contact information for individual responsible for the substitution request.
 - b. Provide Project Name, NC State Project Number, and SCO Project Number.
 - c. Provide product specified, the specification section where specified, and the drawings where the product is indicated.
 - d. Provide a statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
 - e. 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, necessary to accommodate proposed substitution.
 - f. 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.
 - g. Product Data, including drawings and descriptions of proposed products and fabrication and installation procedures.
 - h. Samples, where applicable or required.
 - i. Certificates and qualification data, where applicable or requested.
 - j. List of similar installations for completed projects with project names and addresses and names, email, and phone number, of architects and owners.
 - k. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - l. Research reports evidencing compliance with building code in effect for Project.
 - m. 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.
 - n. Cost information, including a proposal of change, if any, in the Contract Sum.
 - o. 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.
 - p. 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.

4. Designers Action: If necessary, Designer will request additional information or documentation for evaluation within seven (7) calendar days of receipt of a request for substitution. Designer will notify Contractor of acceptance or rejection of proposed substitution within fifteen (15) calendar days of receipt of request, or seven (7) calendar days of receipt of additional information or documentation, whichever is later. Owner is to approve all substitution requests with Designer prior to Designer notifying Contractor of acceptance.
 - a. Forms of Acceptance: Change Order, Construction Change Directive, or Bulletin for minor changes in the Work.
 - b. Use product specified if Designer 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 fifteen (15) calendar days prior to time required for preparation and review of related submittals as defined by the submittal schedule.
 1. Conditions: Designer will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Designer 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. If the Project has identified a sustainable certification goal, the requested substitution provides sustainable design characteristics that specified product provided for achieving sustainable certification prerequisites and credits.
 - c. The Substitution request is fully documented and properly submitted.
 - d. Requested substitution will not adversely affect Contractor's construction schedule.
 - e. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - f. Requested substitution is compatible with other portions of the Work.
 - g. Requested substitution has been coordinated with other portions of the Work.
 - h. Requested substitution provides specified warranty.



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- i. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Not allowed unless otherwise indicated by NC State.

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

SECTION 012600 – CONTRACT MODIFICATION PROCEDURES – CM at Risk Projects

PART 1 – GENERAL

1.1. SUMMARY

A. This section includes:

1. Minor Changes in the Work
2. Owner Initiated Proposal Requests
3. Unit Price Change Orders (General Conditions Article 19 "Method c(1)")
4. Equitable Value Change Orders (General Conditions Article 19 "Method c(2)")
5. Change Order Procedures
6. Field Orders
7. Weather Delays

B. Related Requirements:

1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.
2. Section 012900 "Payment Procedures" for administrative procedures for submitting and processing payment applications.

1.2. 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.

1.3. DEFINITIONS

- A. Overhead: Contractors cost to perform the General Conditions of the Contract and all general requirements detailed in Division 01 of the Specifications, including, but not limited to: project management, scheduling, home office expense, engineering and layout, reproduction expenses, shop drawing processing and coordination, supervision, coordination, small tools, all vehicle expenses, temporary facilities, safety provisions, as built drawings, estimating, and general overhead.

- B. Labor Burden: actual costs of labor burden, limited to including the following. Labor Burden shall not exceed thirty percent (30%) of the actual costs of labor.

1. Actual costs of Social Security (FICA) and Medicare/Medicaid taxes;
2. Unemployment insurance;
3. Health, dental, and vision insurance premiums;
4. Paid employee leave for holidays, vacation, sick leave, and/or petty leave, not to exceed a total of thirty (30) days per year;
5. Retirement contributions;
6. Worker's compensation insurance premiums;
7. Costs of general liability insurance when premiums are computed on payroll amounts

- C. Rain Day (current definition):

1. Any day that rain exceeds one tenth of one inch (0.1").

- D. Weather Day (potential definitions):

1. Precipitation that prevents work on the critical path from being performed for more than four (4) hours in a given day;
2. Project Site conditions, as a result of precipitation (regardless of whether such precipitation occurred on that day or a prior day), such as mud, pooling of water, ice, standing snow, or wet building component surfaces to the extent such site conditions prevent the performance of Work activities on the critical path;
3. Wind speeds, as measured by a project site gauge, exceeding those permissible to use equipment or to perform certain tasks safely (such as not being able to safely use or operate cranes or other aerial equipment) that prevent the performance of Work on the critical path;
4. Installation of temporary protection measures and/or dismantling of equipment necessary to prepare the Project Site for extreme weather events, such as named storms and flooding; removal of temporary protections, clean-up, and restoration of Project Site that prevent the performance of critical path activities.

1.4. ACTION SUBMITTALS

- A. Five Year Climatic Average: No later than fifteen (15) workdays prior to mobilization, submit a five (5) year climatic range average based on statistics kept by the National Weather Service at Raleigh-Durham International Airport.

1.5. MINOR CHANGES IN THE WORK

- A. Designer may issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on "Bulletin" form included in Section 006000 "Project Forms."

1.6. OWNER INITIATED PROPOSAL REQUESTS:

- A. Designer will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time on "Proposal Request" form included in Section 006000 "Project Forms". If necessary, the description will include supplemental or revised Drawings and Specifications.
 1. Bulletins with "Designers Request for Contractor's Proposal" indicated, issued by Designer are not instructions either to stop work in progress or to execute the proposed change.
- B. Within seven (7) calendar days after receipt of Bulletin, or within a duration mutually agreed upon in writing by Owner, Designer, and Contractor, the Contractor shall submit a written proposal to Owner estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
- C. Owner Initiated Proposal Request Format:
 1. Use "Change Order Request" Form included in Section 006000 "Project Forms" or similar form approved by Designer and Owner as a cover page for the Change Order Request.
 2. Backup to support the Change Order Request conforming to the requirements of Unit Price Change Orders or Equitable Value Change Orders as described herein.
 3. Complete "HUB Change Order Form" included in Section 006000 "Project Forms".
 4. Contractor's Schedule Update Report conforming to the requirements of Section 013216 "Construction Progress Schedule". In the narrative portion of the Schedule Update Report, describe the effect of the changes requested, including, but not

limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

5. Completed "HUB Utilization Form" as included in Section 002126 "Guidelines for Recruitment and Selection of Minority Businesses for Participation in the University of North Carolina Construction Contracts".
6. Surety Certification: In the Change Order Request, Contractor shall include a signed statement that states: "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." Contractor shall only notify Surety of change in contract value after a Change Order has been issued, but shall include the statement in each Change Order Request.

1.7. CONTRACTOR INITIATED PROPOSALS:

- A. If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a Change Order Request to Designer and Owner. Claims must be submitted by the Contractor to NC State and Designer within seven (7) calendar days in accordance with Article 20 of the General Conditions.
 1. Use "Change Order Request" Form included in Section 006000 "Project Forms" or similar form approved by Designer and Owner as a cover page for the Change Order Request.
 2. A written description outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 3. Backup to support the Change Order Request conforming to the requirements of Unit Price Change Orders or Equitable Value Change Orders as described herein.
 4. Complete "HUB Change Order Form" included in Section 006000 "Project Forms".
 5. Contractor's Schedule Update Report conforming to the requirements of Section 013216 "Construction Progress Schedule". In the narrative portion of the Schedule Update Report, describe the effect of the changes requested, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 6. Completed "HUB Utilization Form" as included in Section 002126 "Guidelines for Recruitment and Selection of Minority Businesses for Participation in the University of North Carolina Construction Contracts".
 7. Surety Certification: In the Change Order Request, Contractor shall include a signed statement that states: "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." Contractor shall only notify Surety of change in contract value after a Change Order has been issued, but shall include the statement in each Change Order Request.
 8. If the Contractor is requesting to use Contractor Controlled Contingency to fund the change, include a "CM Contingency Request" Form included in Section 006000 "Project Forms".
 9. If the Contractor is requesting to use Reserve Contingency (also referred to as "Bid Savings") to fund the change, include a "Reserve Contingency Request" Form included in Section 006000 "Project Forms".
 10. If the Contractor is requesting to use Owners Contingency to fund the change, include a "Owners Contingency Request" Form included in Section 006000 "Project Forms".

1.8. UNIT PRICE CHANGE ORDERS - Article 19 of the General Conditions, Method c(1)

- A. Description and estimated quantities of unit prices for the project are specified in Section 012200 "Unit Prices". The value of each unit price is indicated on the Form of Proposal incorporated into the Contract Documents.
 - B. Value of the change shall be computed by the application of unit prices based on mutually agreed upon quantities.
 - 1. If the mutually agreed upon quantities exceed the estimated quantity allowance described in Section 012200 "Unit Prices", then either party may elect to proceed with an Equitable Value Change Order in lieu of a Unit Price Change Order. If neither party elects to proceed with an Equitable Value Change Order, then the unit prices shall apply.
 - 2. No Additional markups for Overhead and Profit shall be included in Unit Price Change Orders, as the value of the Unit Prices already includes Contractors Overhead and Profit.
- 1.9. EQUITABLE VALUE CHANGE ORDERS – Article 19 of the General Conditions, Method c(2)
- A. When the method of determining the value of a change order is considered to be an equitable value for the work instead of being controlled by predetermined unit prices, the Contractor, Designer, and Owner shall negotiate and agree upon the equitable value of the change prior to issuance of the Change Order.
 - B. The change order cost breakdown shall differentiate between work performed by the General Contractor and work performed by Subcontractors.
 - C. The Change Order shall be organized in a manner consistent with the Schedule of Values of the contract, as detailed in Paragraph 1.5.B of Section "012900" Payment Procedures".
 - D. The change order cost breakdown shall include the following items:
 - 1. Labor
 - a. Number of hours worked
 - b. Unburdened Labor Rate for each worker
 - c. Actual cost of Labor Burden (not to exceed 30%)
 - d. Overtime, or extra pay for holidays or weekends, may only be a cost item if approved by Owner.
 - 2. Material
 - a. Quantity
 - b. Unit cost of materials, including supporting invoices from material suppliers for all materials being submitted for
 - c. Sales tax
 - 3. Tools & Equipment
 - a. Quantity
 - b. Unit prices for rental for tools (excluding hand tools), equipment, machinery, fuel (if required) and temporary facilities required for the work, including supporting invoices from tool & equipment suppliers for all tools & equipment being submitted for.
 - c. Equipment already on site for the project, and owned by a contractor on site, can not be billed for in a change order.

4. Bonds, Insurance, & Permitting
 - a. Actual costs of premiums for bonds, insurance, and permit fees.
 5. Markups for Overhead & Profit
 - a. All allowance for overhead and profit combined for Construction Manager, prime subcontractors, and all multi-tier subcontractors shall not exceed fifteen percent (15%) of the net cost of the work.
 - b. No allowance for overhead and profit (hereafter referred to as "fee") will be allowed for the Construction Manager until the Change Orders aggregate to a sum in excess of five percent (5%) of the Cost of the Work portion of the GMP. Once this threshold is met, the Construction Manager may add fee not to exceed four percent (4%) of the net cost of the change order. Change Orders to the GMP which authorize additional phases of a project without a change in scope of the originally intended project will not be considered in establishing the threshold for additional Construction Manager fee. In the case of deductible change orders, the Construction Manager shall include no less than five percent (5%) fee.
 6. Net Cost
 - a. The actual costs of materials and supplies incorporated or consumed as part of the project;
 - b. The actual costs of labor expended on the project site;
 - c. 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;
 - d. The actual costs of rental for tools, excluding hand tools; equipment; machinery; and temporary facilities required for the project;
 - e. The actual costs of premiums for bonds, insurance, permit fees and sales or use taxes related to the project;
 - f. Overtime and extra pay for holidays and weekends may be a cost item only to the extent approved by the Owner.
 7. Time
 - a. In the event that the Change Order Request includes a change to the project duration, the Change Order Request shall include the revised project duration and revised dates of Substantial Completion and Final Acceptance.
 - b. Not all time extensions are compensatory. Extended General Conditions for the Contractor will only be allowed in specific circumstances as described in Section 007200 "General Conditions" Article 23.
- E. Subcontractors pricing and backup shall conform to the "Change Order Request" Form included in Section 006000 "Project Forms" or similar form approved by Designer and Owner, with the inclusion of the Subcontractors letterhead.
- F. For change orders that delete any part of the work within the change order and/or contain deductive costs, the back up shall show the original material and labor for the deleted work or costs.

- G. If the change order contains both adds and deducts for the same type of work then the material unit and labor unit costs shown on the back up for the deleted work and the added work shall be the same and the net difference shown.
- H. Deductive change orders shall show the proper reduction in OH&P and the bond.
- I. Failure by the Contractor to provide the information requested in this paragraph shall result in rejection of the change order by the designer and a request for re-submittal. Delay in the processing of the change order due to lack of proper submittal by the Contractor in accordance with this paragraph, or due to errors in the change order calculations shall not constitute grounds for a time extension or basis for a claim.

1.10. CHANGE ORDER PROCEDURES

A. Submission of Change Order Request

- 1. The Contractor shall prepare a Change Order Request conforming to the requirements herein for either an Owner Requested Proposal Request or a Contractor Initiated Proposal and submit the Change Order Request to the Designer for review.

B. Review of Change Order Request

- 1. The designer shall review the Change Order Request to verify correctness and determine if the Contractor's proposed costs are equitable.
- 2. If the Designer determines the Change Order Request is correct and agrees to its accuracy, the Designer will forward the Change Order Request to NC State for their review.
- 3. If NC State determines that the cost is equitable then NC State shall notify the Designer of their acceptance.
- 4. If either the Designer or NC State determines the Change Order Request is incorrect, or the cost has not been agreed upon by the designer and NC State then the Designer shall notify the Contractor that the proposal is rejected and the proposal shall be resubmitted.

C. Interscope / Issuance of Change Order

- 1. Once Change Order Requests have been reviewed and approved by the Contractor, Designer and NC State, the Designer shall initiate a Change Order in the State Construction Office (SCO) web-based Interscope program to incorporate the, or multiple, Change Order Request(s) into the Contract Documents. All Change Orders shall be processed for signatures electronically through Interscope. Directions for using Interscope shall be provided at the Preconstruction Conference.

1.11. FIELD ORDER

- A. Designer may issue a Field Order on "Field Order" Form included in Section 006000 "Project Forms".
- B. Field Order instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order. Field Order contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

- C. Contractor shall maintain detailed records on a time and material basis of work required by the Field Order. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

1.12. WEATHER DELAYS

- A. The Contractors Superintendent shall maintain Daily Weather Logs kept at the jobsite showing the effect of the weather on the progress of the critical path work and the critical path schedule, both initialed by the designer's project representative. All contract time extension requests must incorporate these work logs.
- B. The Contractor may only be entitled to an extension of the contract period for the number of rain days that exceed the normal number of rain days for any given month.
- C. For the purpose of determining extent of delay attributable to unusual weather, a determination shall be made by comparing the Five Year Climatic Average submittal to the Daily Weather Logs prepared by the Contractor.
- D. Time extensions for weather delays do not entitle the Contractor to "extended overhead" recovery and are in all other ways non-compensable.
- E. Not all rain days above the normal number of rain days will warrant a contract time extension. Justification for the request for rain related contract time extensions must also be based on the effect of the rain on critical path work activity in progress during the period of the request and additionally be predicated on the Contractor's diligent prosecution of the work.
 - 1. No additional rain days shall be granted for building projects after the building has been "dried-in" as determined by the designer.
- F. Requests for contract time extensions based on rain days must be received by the designer on or before the 20th day of the month immediately following the month in which the rain occurred. The request must include all required documentation. All parties to this contract agree that the Contractor has no right to claim a contract time extension if the request is not received by the designer in strict accordance with the procedure set forth in this paragraph.
- G. For other types of weather delays, the Contractor is granted one (1) day of contract extension for each day NC State is closed due to weather, however no additional General Conditions will be granted to the Contractor.

PART 2 - PRODUCTS (Not Used)

PART 3 – EXECUTION (NOT USED)

END OF SECTION 012600

SECTION 012613 – REQUEST FOR INTERPRETATION (RFI)

PART 1 – GENERAL

1.1. REQUEST(S) FOR INTERPRETATION (RFI)

- A. General: A Request for Interpretation (RFI) is a Contractor initiated, Owner or Designer formatted, written instrument related to the execution of the Work that is addressed to the Designer. The RFI shall be used by the Contractor as the means for it to ask questions related to the Work; subject to the conditions contained within this article.
 - 1. An RFI which fails to conform to the requirements stated herein, (i.e. is incomplete or contains numerous errors) shall be returned to the Contractor for its completion/rectification without benefit of the Designer's response, in addition, no adjustments for Contract Time or Contract Sum shall be granted for an RFI failing to conform to the requirements stated herein.
 - 2. Each RFI shall be submitted with such promptness as to cause no delay in the Contractor's own work and in that of any subcontractor. No adjustments of Contract Time or Contract Sum will be granted because of failure to have an RFI submitted with sufficient time to allow for the orderly processing of a response by the Designer.
- B. Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in a prompt manner to avoid delays in Contractor's work or the work of its Subcontractors.
- C. Authorship:
 - 1. Each RFI shall originate solely from the Contractor. An RFI submitted to the Designer by an entity, or individual, other than the Contractor (i.e. a Subcontractor) shall be returned to the Contractor.
- D. Prohibitions: RFIs shall not be used for the following:
 - 1. To solicit consideration by the Designer of a "substitution."
 - 2. To request an adjustment of the Contract time.
 - 3. To request an adjustment of the Contract sum.
 - 4. To solicit comment clarification(s) of any required submittal or shop drawing review that was transmitted by the Designer to the Contractor, unless the comments provided conflict with the Contract Documents.
 - 5. RFIs shall not be used to transfer coordination responsibility from the Contractor to the Owner or the Designer.
- E. Procedure:
 - 1. The Contractor shall submit all RFIs on the form supplied in Section 006000 "Project Forms" or on a form approve by the Designer and Owner.
 - 2. Each blank on the RFI form shall be filled in.
 - 3. Each RFI shall be typewritten and shall be forwarded to the Designer electronically.
 - 4. Each RFI shall address one subject.
 - 5. Each RFI shall contain specific reference to the drawing number(s), detail number(s), schedule type(s), bulletin number(s), specification section(s) and paragraph number(s), or other related document(s) which is (are) pertinent to the Contractor's question. The date of each referenced drawing number, bulletin, specification section or other related document shall be identified. In preparing each RFI verify the applicable dimension(s), field conditions, drawing requirements (small through large

scale details), and/or specification section requirements pertaining thereto. Prior to submission of the RFI coordinate the nature of the inquiry with the requirements of other sections or trades as related thereto and responses to previous RFIs. Where supplementary sketches are required to clarify an inquiry the Contractor shall attach supplementary sketches, at large scale, illustrative of the inquiry. Sketches shall include sufficient detail, materials, dimensions, thicknesses, assembly, attachments, relation to adjoining work, structural grid references, and all other pertinent data and information for the Designer to make an informed response.

- a. The Contractor is encouraged to suggest solution(s) to its inquiries, if applicable. Should the Contractor's solution(s) have an impact on Contract Sum or Contract time it shall be so stated within the RFI.
 6. Each RFI shall be dated and sequentially numbered.
 7. Each RFI shall be reviewed, and signed, by the RFI Manager prior to transmitting to the Designer.
 8. Duration of RFI Response Upon Receipt: Seven (7) calendar days, pending complete information.
 - a. If Contractor requires a response within seven (7) calendar days due to the RFI impacting work on the critical path of the project, Contractor shall make all reasonable efforts to submit the RFI in a timely manner, note on the RFI that the RFI impacts work on the critical path and identify the deadline for a response, and verbally communicate (i.e. in person, or over the phone) with the Designer that the specific RFI needs to be expedited. This exception should only be utilized as necessary to ensure the timely completion of the project. Contractor shall not frequently rely on this exception to ensure timely completion of the project.
 9. RFIs rejected for incomplete information shall not be logged, or shall be logged separately and clearly identified from outstanding RFIs with complete information.
 10. RFIs that contain content on the prohibitions list shall be excluded from RFI logs, and be resubmitted properly or tracked in a manner applicable to the request.
 11. RFIs received by Designer after 1:00 p.m. will be considered as received the following working day.
- F. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by RFI Number. Submit RFI Log to Designer and Owner weekly. Use RFI Log Form included in Section 006000 "Project Forms", or similar form approved by Designer and Owner.

PART 2 - PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 012613

SECTION 012900 – PAYMENT PROCEDURES

PART 1 – GENERAL

1.1. SUMMARY

- A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Sections include the following:
 - 1. Section 006000 "Project Forms" for miscellaneous forms required to be submitted with each Payment Application.
 - 2. Section 002126 "UNC System MB Guidelines & Forms 2024" for HUB forms required to be submitted with Payment Applications.
 - 3. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 4. Section 013100 "Project Management & Coordination" for administrative procedures for the requirements of the Subcontractor and Vendor list.
 - 5. Section 013216 "Construction Progress Schedule" for administrative requirements governing preparation and submittal of Contractor's Construction Schedule.
 - 6. Section 013233 "Photographic Documentation" for administrative requirements governing preparation and submittal of Construction Photographs.
 - 7. Section 013523 "NCSU Safety Requirements" for administrative requirements governing the preparation and submittal of the Monthly Safety Report.
 - 8. Section 014400 "Quality Requirements" for administrative requirements governing the Schedule of Tests and Inspections.
 - 9. Section 015000 "Temporary Facilities & Controls" for administrative requirements governing the preparation of the Site Logistics Plan, Erosion-and Sedimentation-Control Plan, Fire-Safety Program, Moisture-Protection Plan, Dust-and HVAC Control Plans, and Vibration Control Plan, as required by project scope of work.
 - 10. Section 017419 "Construction Waste Management & Disposal" for administrative requirements governing the preparation of Construction Waste Management Plan to be submitted by Contractor with Initial Application for Payment.
 - 11. Section 017700 "Closeout Procedures" for the administration requirements for Final Acceptance and the Final Payment Checklist.

1.2. 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.

1.3. 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. PAYMENTWORKS

- A. N.C. State uses PaymentWorks, a third-party onboarding platform that eliminates the risk of business payments fraud and ensures regulatory compliance by automating the complex payee management process.

- B. Prior to any payment being made from N.C. State to the Contractor, Contractor must complete the PaymentWorks supplier registration process.

1.5. SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.
 - 1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with Continuation Sheets.
 - b. Submittals Schedule.
 - c. Items required to be indicated as separate activities in Contractor's Construction Schedule.
 - 2. Submit the Schedule of Values to Owner and Designer at earliest possible date but no later than fifteen working days before the date scheduled for submittal of initial Applications for Payment.
 - a. Initial format of Schedule of Values must be approved by the Owner and Designer prior to submission of the initial Application 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.
 - 1. Identification: Include the following Project identification on the Schedule of Values:
 - a. NC State Project Name and location.
 - b. NC State Project Number, Code & Item, and State Construction Office Project Number.
 - c. Designer's name and address.
 - d. Contractor's name and address.
 - e. Date of submittal.
 - 2. Schedule of Values Organization:
 - a. 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.
 - b. Provide at least one line item for each Specification Section listed in the Table of Contents, except for Divisions 00 and 01.
 - 1) The following sections shall be used for Contractors Division 00 and 01 costs:
 - i. General Conditions.
 - ii. Cleaning.
 - iii. Temporary Facilities.
 - iv. Builders Risk Insurance.
 - v. Bonding.
 - vi. Insurance Programs separate from Builders Risk.
 - vii. Project Closeout.
 - viii. Fee.

- c. When the work of a Specification Section is to be performed by multiple Subcontractors, at least one line item for each Subcontractor shall be provided.
 - d. Provide multiple line items for principal subcontract amounts in excess of five percent of Contract Sum.
 - e. Break down principal subcontract amounts into separate labor and materials items.
 - f. Breakdown of subcontractor's schedule of values must be true and accurate.
 - g. For line items associated with the minority business subcontractor or supplier as identified in Contractor's Affidavit C "Portion of the Work to be Performed by HUB Certified/Minority Businesses".
- 3. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
 - 4. Schedule of Values Updating: Update and resubmit the Schedule of Values no less than seven (7) calendar days before the next Application for Payment when a Change Order(s) results in a change in the Contract Sum for either the Contractor or one of its Subcontractors. Format each change order as described throughout paragraph 1.5.B of this Section. Organize the Schedule of Values so that Change Order(s) are grouped together.

1.6. APPLICATIONS FOR PAYMENT

- A. Each Application for Payment package shall be organized as follows, with each section meeting all the requirements described in subsequent paragraphs herein:
 - 1. Signed cover letter on Contractor's letterhead describing the Payment request including, but not limited to, the NC State Project Number, Code & Item, State Construction Office Project Identification Number, the date of the request, month covered in the application and the number of the application, amount of the request, and a list of included documents.
 - 2. Payment Application Forms.
 - 3. A Consent of Surety Letter that includes the surety's consent to the progress payment and the amount of the payment.
 - 4. Sales Tax Forms, organized by Contractor's summary with Subcontractor backup.
 - 5. Updated Schedule Report, as described in Section 013216, "Construction Progress Schedule".
 - 6. MBE Appendix "E" Form with accurate subcontract amounts and amounts paid.
 - 7. Stored Materials (if applicable), organized by Contractor's summary with Subcontractor backup.
 - 8. Waivers of Mechanic's Lien.
 - 9. Supplemental Information.
- B. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Designer 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.
- C. Payment Application Transmission & Times: Not later than the fifth day of the month, the Contractor shall electronically submit a signed and notarized copy of each Application for Payment to Designer.

- D. Payment Application Forms: Use AIA Document G702 (Application & Certificate for Payment) and AIA Document G703 (Continuation Sheet) as form for Applications for Payment.
- E. Application Preparation: Complete every entry on the form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Designer 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 work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 - 3. Include amounts of Change Orders issued before the last day of construction period covered by application.
 - 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration, if any.
- F. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed.
 - 1. The following requirements apply for Stored Materials:
 - a. Differentiate between items stored on-site and off-site.
 - b. Materials must be customized or fabricated specifically for the project. No raw materials (including, but not limited to piping, conduit, CMU, metal studs and gypsum board, etc.) may be billed as stored materials.
 - c. Contractor is responsible for stored materials and equipment shall remain with the Contractor regardless of ownership title.
 - d. For items stored off-site, the following conditions apply.
 - 1) Material must be stored in an independent, licensed, and bonded warehouse approved by Designer, Owner, State Construction Office, Contractors Insurance Company, and Contractors Surety.
 - 2) Material stored must be clearly identified as NC State property.
 - 3) The warehouse shall be located as close to the project site as possible.
 - 4) Designer must verify that material is stored in compliance with Stored Materials requirements herein.
 - 2. The Stored Materials backup to be included in the Payment Application is as follows:
 - a. Stored Material Summary. Using the standard form provided in Section 006000, provide summary documentation for stored materials indicating the following:
 - 1) Materials previously stored and included in previous Applications for Payment.
 - 2) Work completed for this Application utilizing previously stored materials.
 - 3) Additional materials stored with this application.
 - 4) Total materials remaining stored, including materials with this application.

- b. Designer's verification of materials.
 - c. Provide description of item(s) being stored.
 - d. Location of the warehouse(s) where materials or equipment is stored, and warehouse approval letters from each of: Designer, Owner, State Construction Office, Contractor's Insurance Company, and Contractor's Surety.
 - e. Bill of sale made to Owner stating there will be no additional cost for transportation and delivery of the stored item(s).
 - f. Statement certifying that item, or any part thereof, will not be installed in any construction other than Work under this Contract.
 - g. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials (separate from consent of surety to overall payment application).
 - h. 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.

- G. **Waivers of Mechanic's Lien:** With each Application for Payment, submit notarized waivers of mechanic's lien from every entity who is lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
 - 1. Submit a current Subcontracts and Vendor List.
 - 2. Submit partial waivers on each item for amount requested, before deduction for retainage, on each item.
 - 3. When an application shows completion of an item, submit final or full waivers.
 - 4. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 - 5. Submit final Application for Payment with or preceded by final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 - 6. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.

- H. **Supplemental Information:** With each Application for Payment, but as separate files,, submit the following reports, logs, and submittals:
 - 1. Submittals Schedule updated the same day of the application. After 50% complete on the contract duration, include closeout submittals in a separate Closeout Submittal Schedule.
 - 2. Construction Photographs taken within 2 days of the application for payment documenting progress in the areas under construction.
 - 3. Change Order Log showing issued change orders and potential change orders updated the same day of the application.
 - 4. RFI Log updated the same day of the application.
 - 5. Daily Construction Reports for each work day during the application period.
 - 6. Meeting minutes for meetings conducted by the Contractor during the application period.
 - 7. Monthly Safety Report.

- I. **Initial Application for Payment:** Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
 - 1. List of subcontractors, principal suppliers and fabricators.
 - 2. Products list (preliminary if not final).
 - 3. Schedule of unit prices.

4. List of Contractor's staff assignments and principal consultants.
 5. Copies of permits submitted by Contractor (if any).
 6. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 7. Certificates of insurance and insurance policies.
 8. Performance & payment bonds.
 9. Preconstruction Photographs.
 10. Submittal Schedule
 11. Construction waste management program.
 12. Site logistics & temporary security plans.
 13. Erosion- and Sedimentation Control Plan (if project scope involves site work).
 14. Fire-Safety Program.
 15. Moisture Protection Plan.
 16. Dust and HVAC Control Plan.
 17. Site Specific Safety Plan.
 18. Contractors Site Specific Quality Control Plan.
 19. Noise & Vibration Control Plan
 20. Schedule of Tests & Inspections
- 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. Contractor's Affidavit for Release of Liens.
 2. Contractor's Affidavit of Payment of Debts and Claims.
 3. Consent of Surety for Final Payment.
 4. Certificate of Compliance (Completed by Designer)
 5. Certificate of Completion (Completed by Designer)
 6. Completed Tax Statement and Form.
 7. MBE Appendix "E" Form with accurate subcontract amounts and amounts paid.
 8. Survey of New and Existing Sub-Surface Utilities.
 9. Warranties & Guarantees required by the Contract Documents.
 10. Evidence of completion of Project closeout requirements, including, but not limited to:
 - a. Transmittal of required Project Record Documents to Owner.
 - b. Evidence of completion of demonstration and training.
 - c. Transmittal of Attic Stock.
 - d. Reconciliation of Allowances.
 11. Builders Risk Insurance Cancellation Notice.
 12. Certificates of State Agencies required by State Law.
 13. Certification all keys issued to Contractor have been returned to N.C. State Lock Shop.
 14. Certification of no outstanding utility bills.
 15. Final Completion Construction Photographs.
- 1.7. REVIEW OF APPLICATION FOR PAYMENT
- A. Draft Copy: Submit draft (pencil) copy of the Application for Payment ten days prior to due date for review by Designer.
 - B. Draft Copy Review Meeting: The Owner, Designer and Contractor shall meet prior to payment application due date to review the draft (pencil) copy of the Application for Payment. Questions resulting from this review shall be answered by the Contractor and clarified prior to receipt of the official copy of the Application for Payment.

- C. Upon receipt of the official Application for Payment and other documentation as required by the Designer and Owner, the Designer shall review the documents received to determine if they correspond to the agreements reached during the draft copy review meeting. If necessary, the Contractor shall revise the Application for Payment to correspond to the agreements reached, execute the Certificate for Payment, and forward the executed copies to the Owner.
- D. The Owner and Designer will rely on the accuracy and completeness of the information furnished by the Contractor. Issuance of a Certificate of Payment, and subsequent payment thereof will not be deemed to represent that the Owner or Designer performed audits of the supporting data, and does not waive Owners right to audit the project.

1.8. INSPECTION & AUDIT

- A. Contractor's "records" shall upon reasonable notice be open to inspection and subject to audit and/or reproduction during normal business working hours. An NC State representative or an outside representative engaged by NC State may perform such audits. NC State or its designee may conduct such audits or inspections throughout the term of this contract and for a period of three years after final payment or longer if required by law.
- B. Contractor's records as referred to in this contract shall include any and all information, materials and data of every kind and character, including without limitation the following:
 - 1. Records
 - 2. Books
 - 3. Documents
 - 4. Subscriptions
 - 5. Recordings
 - 6. Agreements
 - 7. Purchase Orders
 - 8. Leases
 - 9. Contracts
 - 10. Commitments
 - 11. Arrangements
 - 12. Notes
 - 13. Daily diaries
 - 14. Superintendent reports
 - 15. Drawings
 - 16. Receipts
 - 17. Vouchers and memoranda, and
 - 18. Any and all other agreements, sources of information and matters that may in NC State's judgment have any bearing on or pertain to any matters, rights, duties or obligations under or covered by any Contract Document.
- C. Such records shall include (hard copy, as well as computer readable data if it can be made available):
 - 1. written policies and procedures;
 - 2. time sheets;
 - 3. payroll registers;
 - 4. payroll records;
 - 5. cancelled payroll checks;
 - 6. subcontract files (including proposals of successful and unsuccessful bidders, bid recaps, etc.);
 - 7. original estimates;
 - 8. estimating work sheets;

9. correspondence;
10. change order files (including documentation covering negotiated settlements);
11. back charge logs and supporting documentation;
12. invoices and related payment documentation;
13. general ledger entries detailing cash and trade discounts earned;
14. insurance rebates and dividends; and
15. any other Contractor records which may have a bearing on matters of interest to NC State in connection with the Contractor's dealings with NC State (all foregoing hereinafter referred to as "records") to the extent necessary to adequately permit evaluation and verification of:
 - a. Contractor compliance with contract requirements,
 - b. Compliance with NC State's business ethics policies, and
 - c. Compliance with provisions for pricing change orders, invoices or claims submitted by the Contractor or any of his payees.

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 SUMMARY

- A. This 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. Construction Management Software.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Section 005436 "BIM Modeling Exhibit" for requirements associated with the Contractors preparation of the BIM Model.
 - 2. Section 012613 "Requests for Information" for requirements associated with RFIs.
 - 3. Section 013119 "Project Meetings" for requirements associated with project meetings.
 - 4. Section 013200 "Construction Progress Documentation" for preparing and submitting the Contractor's Construction Schedule.
 - 5. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.

1.2 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.

1.3 INFORMATIONAL SUBMITTALS

- A. Subcontractor and Vendor List: Within fifteen (15) calendar days of Notice to Proceed, prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Use CSI Form 1.5A in Section 006000 "Forms", or similar form approved by Designer and Owner. Include the following information in tabular form:
 - 1. Name, address, and telephone number of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.
- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
 - 1. Post copies of list in project meeting room, in temporary field office, on Project Web site, and by each temporary telephone. Keep list current at all times.

1.4 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in various Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
 - 4. Arrange pipes, ducts, conduits, and other overhead systems in an orderly manner when indicated to remain exposed.
- B. If necessary, 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 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.

1.5 ACTION SUBMITTAL - COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
 - 1. Contractor shall prepare MEPFP Coordination Drawings and submit to Designer and Owner within fifteen (15) calendar days after Notice to Proceed.

2. 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 Designer indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- C. Coordination Drawing Organization: Organize coordination drawings as follows:
 1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
 2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
 3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
 4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
 5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
 6. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
 7. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1 inch in diameter and larger.

- b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
 - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
- 8. Fire-Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
- 9. Telecommunications Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1 inch in diameter and larger.
 - b. Location of pull boxes and junction boxes, dimensioned from column center lines.
- 10. Audiovisual Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1 inch in diameter and larger.
 - b. Location of pull boxes and junction boxes, dimensioned from column center lines.
- 11. Security & Access Control Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1 inch in diameter and larger.
 - b. Location of pull boxes and junction boxes, dimensioned from column center lines.
- 12. Architectural Work: Show the following:
 - a. Any features identified in the Drawings as requiring coordination with other trades listed herein.
- 13. Review: Designer will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Designer or Owner determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Designer will so inform Contractor, who shall make changes as directed and resubmit.
- D. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
 - 1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
 - 2. File Preparation Format: DWG, version within two (2) years of the Notice to Proceed, operating in Microsoft Windows operating system.
 - 3. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format and Portable Data File (PDF) format.
 - a. Refer to Section 017700 "Closeout Procedures" for additional requirements for CAD files to be included in the closeout documents.

4. BIM File Incorporation: Develop and incorporate coordination drawing files into Building Information Model established for Project.
 - a. Perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Designer.
5. Designer will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
 - a. Designer makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
 - b. Digital Data Software Program: Drawings are available in Autodesk Revit 2020.
 - c. Digital data files will be provided in the software and format that is used to prepare the Contract Documents. Translations to different programs or modifications to the drawing setup will be the responsibility of the Contractor.
 - d. Contractor shall execute a data licensing agreement in the form of Agreement included in Section 006000 "Project Forms".

1.6 CONSTRUCTION MANAGEMENT SOFTWARE

- A. Provide, administer, and use a Construction Management Software (e.g. Plangrid, Procore, or similar) for purposes of hosting and managing project communication and documentation until Final Acceptance. Construction Management Software shall include the following functions:
 1. Project directory.
 2. Project correspondence.
 3. Meeting minutes.
 4. Contract modifications forms and logs.
 5. RFI forms and logs.
 6. Task and issue management.
 7. Photo documentation.
 8. Schedule and calendar management.
 9. Submittals forms and logs.
 10. Drawing and specification document hosting, viewing, and updating.
 11. Online document collaboration.
 12. Reminder and tracking functions.
 13. Archiving functions.
- B. Provide Construction Management Software user licenses for use of the Owner, Owner's Consultants, Owner's Commissioning Authority, Designer, and Designer's consultants.
 1. Provide system access privileges for Designer and their consultants to facilitate the following:
 - a. A complete process for online document collaboration during submittal reviews.
 - b. Preparation of reports from the entire database, including archived and closed items.
- C. On completion of Project, provide one complete archive copy of Construction Management Software files to Owner and to Designer in a digital storage format acceptable to Owner.



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- D. Contractor, subcontractors, and other parties granted access by Contractor to Construction Management Software shall execute a data licensing agreement in the form of Agreement included in Section 006000 "Project Forms".

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013119 – PROJECT MEETINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative provisions for meetings regarding the Project including, but not limited to, the following:
 - 1. General Meeting Requirements
 - 2. Preconstruction Conference
 - 3. Prescheduling Conference
 - 4. Monthly Progress Meeting
 - 5. Weekly Progress Meeting
 - 6. Preinstallation Conferences
 - 7. Pay Application Review Meeting
 - 8. Project Closeout Conference
 - 9. Sustainable Design Coordination Conference
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Section 013100 "Project Management and Coordination" for preparing and submitting the Subcontractor List.
 - 2. Section 013200 "Construction Progress Documentation" for preparing and submitting the Contractor's Construction Schedule and schedule reports
 - 3. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 4. Section 017700 "Closeout Procedures" for coordinating Contract closeout.

1.2 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.

1.3 GENERAL MEETING REQUIREMENTS

- A. Schedule and physically conduct meetings at Project site or within a safe meeting space in close proximity to the Project, unless otherwise indicated.
 - 1. Use of virtual meetings is allowable, but at least one representative from each entity invited to the meeting should be in person to facilitate discussion and item resolution.
- B. Requirements herein apply to all meetings, regardless of the meeting organizer.
 - 1. Attendees: Meeting organizer shall inform participants and others involved, and individuals whose presence is required, of date and time of each meeting.
 - a. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 2. Agenda: Meeting organizer shall prepare the meeting agenda and distribute the agenda to all invited attendees no less than three (3) calendar days prior to the meeting.

3. Minutes: Meeting organizer shall designate a note taker for the meeting. Record significant discussions and agreements achieved. Meeting organizer shall distribute the meeting minutes to all meeting invitees within three (3) calendar days of the meeting.
4. Notification: Inform participants three (3) calendar days prior to meetings not regularly scheduled.

1.4 PRECONSTRUCTION CONFERENCE

- A. Designer shall schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner, State Construction (if applicable) and Contractor, but no later than fifteen (15) calendar days after execution of the Agreement.
 1. Attendees:
 - a. Authorized representatives of Owner
 - b. Owner's Commissioning Authority
 - c. Designer, and their consultants;
 - d. Contractor and its superintendent;
 - e. major subcontractors;
 - f. manufacturers;
 - g. suppliers;
 - h. testing laboratory representatives;
 - i. Other concerned parties shall attend the conference.
 2. Agenda: Use the State Construction Office Preconstruction Conference Agenda included in Section 006000 "Project Forms" as a basis for creating the agenda for the Preconstruction Meeting. Do not change the formatting or contents of items 1 through 12 of the State Construction Office Preconstruction Conference Agenda. Beginning with new note 13, discuss items of significance from the list below that could affect progress, including the following:
 - a. Review Subcontract List;
 - b. Requirements in individual Specification Sections for preconstruction responsibilities;
 - c. Attach a full Construction Schedule Report from the Contractor to the meeting notes;
 - d. Project coordination;
 - e. Site Logistics Plan;
 - f. Contractors Quality Control Plan;
 - g. Erosion & Sedimentation Control Plan;
 - h. Fire Safety Program;
 - i. Moisture-Protection Plan;
 - j. Dust and HVAC Control Plan;
 - k. Phasing;
 - l. Hazardous Material Remediation Plan;
 - m. Critical work sequencing and long-lead items.
 - n. Designation of key personnel and their duties.
 - o. Lines of communication.
 - p. Procedures for processing Requests for Interpretation (RFIs.)
 - q. Procedures for processing Bulletins and Architects Supplemental Instructions (ASI's) and the difference between the two.
 - r. Procedures for processing submittals, including electronic photography requirements and sample submittal review procedures.
 - s. Procedures for processing substitution requests.

- t. Procedures for testing and inspecting.
- u. Distribution of the Contract Documents.
- v. Preparation of Record Documents.
- w. Use of the premises.
- x. Work restrictions.
- y. Working hours.
- z. Owner's occupancy requirements.
- aa. Responsibility for temporary facilities and controls.
- bb. Procedures for disruptions and shutdowns.
- cc. Construction waste management and recycling.
- dd. Office, work, and storage areas.
- ee. Equipment deliveries and priorities.
- ff. First aid.
- gg. Security.
- hh. Progress cleaning.

1.5 SCHEDULING CONFERENCE

- A. Construction Manager shall schedule and conduct a Scheduling Conference prior to mobilization to the site.

- B. Attendees:
 - 1. Contractor's Preconstruction Manager, Project Manager, and Superintendent
 - 2. Contractor's Scheduler or Scheduling Consultant
 - 3. Authorized Representatives of the Owner (Optional)
 - 4. Designer, and their consultants (Optional)

- C. Contractor and all its subcontractors shall include a minimum of five (5) full work days in their base bid to attend the Scheduling Conference.

- D. Agenda:
 - 1. Develop the Project Schedule that conforms to the contract time.
 - 2. Review methods and procedures related to Contractor's Construction Schedule, including, but not limited to, the following:
 - a. Review software limitations and content and format for reports.
 - b. Verify availability of qualified personnel needed to develop and update schedule.
 - c. Discuss constraints, including phasing work stages and interim milestones.
 - d. Review delivery dates for Owner-furnished products
 - e. Review schedule for work of Owner's separate contracts.
 - f. Review submittal requirements and procedures.
 - g. Review time required for review of submittals and resubmittals.
 - h. Review requirements for tests and inspections by independent testing and inspecting agencies.
 - i. Review time required for Project closeout and Owner startup procedures, including commissioning activities.
 - j. Review and finalize list of construction activities to be included in schedule.
 - k. Review procedures for updating schedule.

- E. At the end of the Prescheduling Conference, the Contractor shall deliver to Owner and Designer a Project Schedule, signed by the Contractor's Project Manager and Superintendent, and each Project Manager and Superintendent for each of Contractor's Subcontractors, as identified on the Subcontract List.
 - 1. No application for payment will be processed until this schedule is accepted by the Designer and Owner.
 - 2. The signed original copy of the Project Schedule resulting from the Prescheduling Conference shall be displayed at the jobsite.

1.6 MONTHLY PROGRESS MEETING

- A. Designer shall conduct progress meetings at monthly intervals.
 - 1. Attendees:
 - a. Designer
 - b. Designer Consultants whose discipline is under active construction or will begin within the next month
 - c. Owner
 - d. State Construction Monitor
 - e. Contractor's Project Manager and Superintendent
 - f. The meeting is open to the following optional attendees: subcontractors, material suppliers, and any others who contribute to the progress of the project.
 - 2. Agenda:
 - a. Use Monthly Meeting Agenda included in Section 006000 "Project Forms" as a basis for the Monthly Meeting. Items should remain on the agenda until all actions associated with the note are complete.
 - b. Review and correct or approve minutes of previous progress meeting.
 - c. 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.
 - d. Review Designer's Logs and discuss issues, Information, Instructions, Proposals and Modifications.
 - e. Review any pending change orders or field orders.
 - f. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - 3. Reporting:
 - a. Designer shall distribute minutes of the meeting to each party present and to parties who should have been present within three (3) calendar days of the meeting.

- b. Designer shall upload a copy of the meeting minutes into the State Construction Office InterSCOPE database as Package Documents.

1.7 WEEKLY PROGRESS MEETINGS

- A. Contractor shall conduct progress meetings at weekly intervals.

- 1. Coordinate dates of meetings with preparation of payment requests.
- 2. Attendees:
 - a. Representatives of Owner;
 - b. Owner's Commissioning Authority;
 - c. Designer;
 - d. Contractor's Project Manager and Superintendent;
 - e. Contractor may invite their subcontractors, suppliers, and/or other entities concerned with current progress or involved in planning, coordination, or performance of future activities.
- 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:
 - 1) 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.
 - 2) Review schedule for the upcoming two-week period.
 - 3) Discuss long-term schedule needs as necessary.
 - 4) Review Upcoming Work Summary report, as described in Section 013216 "Construction Progress Schedule".
 - b. Review present and future needs of each entity present, including the following:
 - 1) Safety, hazards and risks.
 - 2) Change Order Requests and Change Orders.
 - 3) Request for Information.
 - 4) Submittals.
 - 5) Designer Inspection Reports.
 - 6) Erosion & Sedimentation Update (if applicable).
 - 7) Review condition of tree protection (if applicable).
 - 8) Progress cleaning and site cleanliness.
 - 9) Changes to Site Logistics or Emergency Action Plan.
 - 10) Sequence of operations.
 - 11) Resolution of BIM component conflicts.
 - 12) Status of upcoming samples and/or mockups, and location for review.
 - 13) Deliveries.
 - 14) Off-site fabrication.
 - 15) Access.

- 16) Site utilization.
 - 17) Temporary facilities and controls.
 - 18) Atypical work hours.
 - 19) Quality and work standards.
 - 20) Pending changes
 - 21) Pending claims and disputes.
 - 22) Documentation of information for payment requests.
 - 23) Testing and inspection requirements.
 - 24) Other business relating to the Work.
4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present. Include a brief summary, in narrative form, of progress since the previous meeting and report.
- 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.

1.8 PREINSTALLATION CONFERENCES

- A. Conduct all preinstallation conferences at Project site before each construction activity that requires coordination with other construction.
- 1. Attendees: Contractor, Subcontractor responsible for the work being discussed at the conference, Designer (architect at a minimum, consultant responsible for the design of the work to also be in attendance), NC State's Project Manager, Commission Agent (if required) and other interested and/or impacted parties within NC State.
 - 2. Agenda: Contractor shall prepare the meeting agenda and distribute the agenda to all invited attendees at least three (3) workdays prior to the meeting. 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 RFI.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Review of mockups.
 - i. Possible conflicts.
 - j. Compatibility requirements.
 - k. Time schedules.
 - l. Weather limitations.
 - m. Manufacturer's written instructions.
 - 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. Minutes: Contractor shall record significant conference discussions, agreements, and disagreements, including required corrective measures and actions. Contractor shall distribute minutes of the meeting to each party present and to other parties requiring information within three (3) workdays of the meeting.
 - 4. Notification: Conference shall occur no less than ten (10) workdays prior to activity beginning.
 - 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.
- B. The following preinstallation conferences are required by NC State. Additional preinstallation conferences may be specified by the Designer within specific Specification Sections within the Contract Documents.
- 1. Demolition;
 - 2. Grading, installation of construction fence, underground utility services;
 - 3. Waterproofing, damp-proofing;
 - 4. Face brick installation;
 - 5. Window, Storefront, Curtain wall and other glazing installations;
 - 6. Landscape;
 - 7. Roofing installation;
 - 8. Flooring installation;
 - 9. Structural Concrete;
 - 10. Structural Steel;
 - 11. Casework/Fumehoods;
 - 12. Fire Alarm-Sprinkler System;
 - 13. Card reader/Security, Door Hardware;
 - 14. Audio/Visual;
 - 15. Replacement and New Installation of Transformers, Switches, etc.

1.9 PAYMENT APPLICATION MEETING

- A. Contractor shall conduct a payment application meeting at monthly intervals.
 - 1. Meeting shall occur between submission of the pencil copy of the payment application to the Designer on the 25th day of the month and the last day of the month.
 - 2. Attendees:
 - a. Owners Project Manager
 - b. Designer;
 - c. Contractor's Project Manager.
 - 3. Agenda: Review and correct pencil copy of payment application.

1.10 PROJECT CLOSEOUT CONFERENCE

- A. Contractor shall schedule and conduct a project closeout conference, at a time convenient to Owner, State Construction, and Designer, but no later than 80% completion of the Contract Duration, or 90 days prior to the scheduled date of Final Acceptance, whichever is earlier.

1. Conduct the conference to review requirements and responsibilities related to Project closeout.
2. Attendees:
 - a. Authorized representatives of Owner,
 - b. Owner's Commissioning Authority,
 - c. Designer, and their consultants;
 - d. Contractor and its superintendent;
 - e. Major subcontractors;
 - f. Suppliers;
 - g. Other concerned parties shall attend the meeting.
3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Review Completion Schedule.
 - b. Review Final Acceptance Checklist, as included in Section 006000 "Project Forms".
 - c. Preparation of record documents.
 - d. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - e. Submittal of written warranties.
 - f. Requirements for preparing operations and maintenance data.
 - g. Requirements for delivery of material samples, attic stock, and spare parts.
 - h. Requirements for demonstration and training.
 - i. Preparation of Contractor's punch list.
 - j. Requirements prior to the preparation of the Designer's punch list.
 - k. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - l. Submittal procedures for closeout documents.
 - m. Owner's partial occupancy requirements.
 - n. Installation of Owner's furniture, fixtures, and equipment.
 - o. Responsibility for removing temporary facilities and controls.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013119

SECTION 013200 – CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Daily construction reports.
 - 2. Material location reports.
 - 3. Unforeseen condition reports.
 - 4. Special reports.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Section 006000 "Project Forms" for Daily Report and Stored Material Summary forms.

1.2 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.

1.3 REPORT SUBMISSION FREQUENCY

- A. Daily Construction Reports: Submit weekly.
- B. Material Location Reports: Submit at monthly intervals.
- C. Site Condition Reports: Submit at time of discovery of differing conditions.
- D. Special Reports: Submit at time of unusual event.

1.4 INFORMATION SUBMITTALS

- A. Daily Report Template: Submit a copy of Contractors Daily Report Template prior to mobilization.

1.5 DAILY CONSTRUCTION REPORTS

- A. Prepare a daily construction report recording the following information concerning events at Project site:
 - 1. Project Name, SCO Project ID #, NC State Project #
 - 2. Report #.
 - 3. Date & Time report was generated.
 - 4. Weather data: overhead conditions, precipitation (if so, type & how much), temperature (high & low), impact on progress.
 - 5. Document Daily Safety Briefing (refer to Contractor Safety Guidelines 4.0/E).
 - 6. Report Daily Safety Inspections (refer to Contractor Safety Guidelines 4.0/E).
 - 7. Sediment & Erosion Control.
 - 8. Work performed (include all major trades).
 - 9. Total number of Contractor's workers on site.
 - 10. List of subcontractors and the number of their workers at Project site.

11. List of Owner's personnel and the nature of their business at the Project Site.
12. List of other Owner's contractors and the number of their workers at Project site.
13. Equipment at Project site.
14. Material deliveries.
15. Transmittal of salvage or attic stock to Owner, including the list of materials and name of Owner's representative taking possession of materials.
16. Difficulties encountered that may cause delay.
17. Days of no work & reason.
18. Accidents & near misses.
19. Meetings and significant decisions.
20. Unusual events (refer to special reports).
21. Stoppages, delays, shortages, and losses.
22. Report of utility shutdowns performed by Owner at Contractor's request, including, but not limited to: start time, finish time, progress of work, and personnel involved.
23. Meter readings and similar recordings.
24. Tests and inspections, including name(s) of testing and inspection agency(ies).
25. Emergency procedures.
26. Orders and requests of authorities having jurisdiction.
27. Change Orders received and implemented.
28. Field Orders received and implemented.
29. Bulletins, Architect's Supplemental Instructions, or other sketches received.
30. Services connected and disconnected.
31. Equipment or system tests and startups.
32. Substantial Completions achieved (in part or in full) and Final Acceptances authorized.

1.6 UNFORSEEN CONDITION REPORTS:

- A. Immediately on discovery of unforeseen conditions, prepare a detailed report using a Request for Interpretation (RFI). Include a detailed description of the differing conditions, including photos or field reports as necessary to describe and detail the unforeseen condition, together with recommendations for resolving the condition.

1.7 SPECIAL REPORTS

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 – CONSTRUCTION PROGRESS SCHEDULE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Definitions.
 - 2. Reports.
 - 3. Quality Assurance.
 - 4. Coordination.
 - 5. Work Breakdown Structure Overview (WBS).
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Section 012900 "Payment Procedures" for submitting the Schedule of Values.
 - 2. Section 013100 "Project Management and Coordination" for submitting and distributing meeting and conference minutes.
 - 3. Section 013300 "Submittal Procedures" for submitting schedules and reports.
 - 4. Section 014000 "Quality Requirements" for submitting a schedule of tests and inspections.
 - 5. Section 017700 "Closeout" for administrative requirements about Contractor's Statement of Completion with Request for Designers Inspection, Substantial Completion, and Final Acceptance.

1.2 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.

1.3 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 activities are activities on the critical path. They must start and finish on the planned early start and finish times.
 - 2. Predecessor activity is an activity that must be completed before a given activity can be started.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- C. Critical Path: The longest continuous chain of activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- D. Event: The starting or ending point of an activity.
- E. Float: The measure of leeway in starting and completing an activity.

1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the following activity.
 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- F. Fragnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.
- G. Major Area: A story of construction, a separate building, or a similar significant construction element.
- H. Milestone: A key or critical point in time for reference or measurement.
- I. Network Diagram: A graphic diagram of a network schedule, showing activities and activity Relationships.
- J. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.
- K. Work Breakdown Structure (WBS): A deliverable-oriented hierarchical decomposition of the work to be executed by the project team to accomplish the project, with each descending level of the WBS representing an increasingly detailed definition of the project work.

1.4 REPORTS

- A. Format for Submittals: Submit required submittals in the following format, unless indicated otherwise:
1. Working electronic copy of schedule file in contractor's scheduling software utilized.
 2. PDF electronic file.
- B. Contractor's Initial Construction Schedule: Initial project construction schedule conforming to the requirements herein, submitted within fifteen (15) calendar days of Notice to Proceed. No Applications for Payment will be processed without an approved Initial Construction Schedule. Once approved, this schedule becomes the "Baseline" schedule.
1. Submit a working electronic copy of schedule, exported to Microsoft Project (.mpp) format (regardless of the software used to generate the schedule), and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.
- C. Construction Finish Schedule: At 80% project completion (determined by duration not value of work in place), submit a schedule illustrating tasks remaining to complete the project.
- D. Construction Schedule Update Report:
1. Submit, with each Application for Payment, an electronic copy of the Construction Schedule Update Report in .pdf format containing all requirements herein as well as a working electronic copy of the schedule in Microsoft Project (.mpp) format.
 2. Cover Letter: Cover letter shall describe the contents of the report including the following:

- a. Project Name and NC State Project Number,
 - b. SCO Project ID Number,
 - c. Date of Report,
 - d. Contents of the Report,
 - e. Schedule compliance update and status of recovery schedule (if applicable)
 - f. Signed by the Contractor's Project Manager.
3. Signature Page: A signature page (or pages if necessary) must be included in the Update Report, so that in addition to the Contractor's signature representing the accuracy of the updated Schedule, the Project Manager for each Subcontractor (as identified in the Subcontract List submittal) can sign to document their agreement to the updated schedule.
 - a. If a Subcontractor does not agree to the updated schedule, they shall write "Exceptions Taken" in the signature line for their company and submit to Contractor a separate written summary of their exceptions and/or inaccuracies on Subcontractors letterhead. Contractor shall include the Subcontractor's written summary, and responses to the exceptions in the Narrative section of the Schedule Update Report.
4. Narrative: Contractor shall include, separate from the Cover Letter, a Narrative that describes what activity changes happened on the project, including the following:
 - a. Summary of work completed since the last report,
 - b. Missing data,
 - c. Recent and upcoming changes,
 - d. Documented delays,
 - e. Potential delays, and
 - f. Other facts.
5. CPM Activity Report:
 - a. Formatting:
 - 1) Plotted to an 11x17 page with landscape orientation,
 - 2) List of all activities sorted by WBS, activity number, and then early start date, or actual start date if known.
 - 3) Include the Gantt chart in the report, scaled so all information below and the chart fit on one page width.
 - b. Each activity line in the report shall contain the following:
 - 1) Activity number,
 - 2) Activity description,
 - 3) Original duration,
 - 4) Remaining duration,
 - 5) Early start date,
 - 6) Early finish date,
 - 7) Late start date,
 - 8) Late finish date,
 - 9) Predecessor & Successor Activity Numbers, and
 - 10) Total float in working days.
6. Critical Path Report: Using the same format of the CPM Activity Report, generate a report showing only items on the Critical Path of the Project.

7. Total Float Report:
 - a. Format: 8-1/2x11, portrait orientation
 - b. List of all activities sorted by total float, Criticality (Critical: 0 days float, Near Critical: 1 to 10 days of float, and Not Critical: 11+ days of Float), WBS, then activity number.
 - c. Each activity line in the report shall contain the following:
 - 1) Activity number,
 - 2) Activity description,
 - 3) Original duration,
 - 4) Remaining duration,
 - 5) Early start date,
 - 6) Early finish date,
 - 7) Total float in working days.
 8. Change Report, as described in Paragraph 2.2.G. of this Section.
 9. Earnings Report: Compilation of Contractor's total earnings from the Notice to Proceed until most recent Application for Payment in tabular and chart format.
- E. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
1. Unresolved issues.
 2. Unanswered RFI.
 3. Rejected or unreturned submittals.
 4. Notations on returned submittals.
 5. Pending modifications affecting the Work and Contract Time.

F.

1.5 QUALITY ASSURANCE

- A. Contractors Scheduler, or Scheduling Consultant, Qualifications: Contractor shall employ, or contract with, an experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Designer's or Owner's request.
 1. Qualification Data: Submit the resume and/or qualifications for Contractors Scheduler or the Contractors scheduling consultant. Owner reserves the right to approve, reject, or change the Contractors Scheduler as necessary to ensure the project stays on schedule without incurring additional costs.
- B. Conduct Prescheduling conference at Project site to comply with requirements in Section 013119 "Project Meetings."

1.6 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 parties involved.

2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.
- C. Coordinate Contractor's construction schedule with Owner's construction schedule for Owner's own forces. Revise Contractor's construction schedule, if necessary, after a joint review and mutual agreement. The construction schedule shall then constitute the schedule to be used by Contractor, separate contractors, and Owner until subsequently revised.

1.7 WORK BREAKDOWN STRUCTURE (WBS) OVERVIEW

- A. All schedules prepared by the contractor shall generally conform to the following Work Breakdown Structure (WBS). Additional details for each WBS are included in subsequent paragraphs in this Section.
 1. Milestones.
 2. Inspections & Outages.
 3. Preconstruction.
 4. Construction.
 5. Closeout.
- B. Milestones
 1. Include, at a minimum, the following milestones in the schedule, within the following structure:
 - a. Contract Dates (if project includes multiple phases, include the following for each phase)
 - 1) Contract Execution
 - 2) Notice to Proceed
 - 3) 15 Days after NTP (due date for various submittals)
 - 4) 30 Days after NTP (due date for various submittals)
 - 5) 80% Duration Complete
 - 6) Contractor's Statement of Completion with Request for Designer's Inspection
 - 7) Substantial Completion
 - 8) Final Acceptance
 - b. Coordination Effort
 - 1) MEPFP Coordination Drawings Ready for Review (can be multiple milestones if required by the project)
 - 2) Casework & Fume Hood Submittals & Shop Drawings Ready for Review, if necessary (due within 30 calendar days from Notice to Proceed)
 - c. SCO Monthly Meeting Dates
 - d. Progress Milestones
 - 1) Chilled Water Complete.
 - 2) Footings Complete.
 - 3) Structure Complete.
 - 4) Roof Complete.
 - 5) Envelope Complete / Dry-in.
 - 6) Sitework Complete.

C. Tests, Inspections & Outages

1. Contractor Tests & Inspections:
 - a. Stair & Ramp Survey (if required)
 - b. Moisture Testing for Flooring
 - c. Contractors Pre-Final Punch List
 - d. Testing, Adjusting, and Balancing
 - e. Pre-Functional Testing
2. Designer Tests & Inspections:
 - a. Backflow Preventer Test (if not by Contractor)
 - b. Designer Punch List
 - c. Designer Pre-Electrical Inspection
3. Designer and NC State Tests & Inspections:
 - a. In-wall Inspections
 - b. Above Ceiling Inspections
 - c. Generator Load Test
 - d. Fire Pump Test
 - e. Fire Sprinkler Main Drain Tests
 - f. Pre-Final Inspections
 - g. 100% Test of the fire detection and alarm system
 - h. Third Party materials testing / special inspections / commissioning
 - i. Piping Pressure Testing
 - j. Telecom/Data Wiring Tests & As-Built
 - k. Underground piping, ductbanks, and other components prior to backfill
 - l. Fume Hood Commissioning & Testing
 - m. Final Inspection for Project Acceptance
4. Include, at a minimum, the following tests & inspections, conducted by AHJ
 - a. NFPA, DOI, and DOL Tests
 - b. Beneficial Occupancy
 - c. Final Inspections
5. Include Utility Outages on the schedule, scheduled in accordance with the requirements described in Section 011400 "Work Restrictions".
6. General Requirements
 - a. The Contractor should include a reasonable corrective work period after each inspection so that Contractor has time to work off deficient items identified during each inspection. However, since the duration shown for each corrective work period will be at the Contractor's discretion, and the amount of corrective work needed will be relative to Contractor's quality of work, if the corrective work period takes longer than the time identified on the schedule, it does not alleviate Contractor's requirement to achieve the Contract Milestone dates.

D. Preconstruction

1. Include, at a minimum, the following preconstruction items:

- a. Procurement & Submittals (General) - repeat for each item with a procurement duration longer than six (6) weeks.
 - 1) Prepare Submittal
 - 2) A/E Review Submittal (20 calendar days)
 - 3) Fabricate / Deliver Material
 - b. Procurement & Submittals (Sprinkler)
 - 1) Prepare Submittal
 - 2) A/E Review Submittal (20 calendar days)
 - 3) North Carolina State Construction Office Review (approx. 30 calendar days)
 - 4) Fabricate / Deliver Material
 - c. BIM Coordination
 - d. Safety
 - 1) NCSU Review of Activities (Refer to Paragraph 4.0 of NCSU Safety Manual)
 - 2) NCSU Lift Plan Review (50 calendar days)
 - e. Mockups
- E. Construction
- 1. Work by Contractor – Organized at Contractor's discretion, conforming to reasonably accepted construction standards and coordinated with the Schedule of Values.
 - 2. Work by Owner - coordinate with Section 011116, "Work by Owner"
 - 3. Acceptance Phase - Include a section that shows an Acceptance Phase showing all activities preparing for Final Acceptance.
 - a. This Acceptance Phase shall include all activities by Contractor, Designer, Owner, and Inspectors required to complete the project. Coordinate activities with Section 017700 "Closeout".
- F. Closeout
- 1. Include, at a minimum, the following activities in the closeout section:
 - a. Preparation of O&M's (listed by Division)
 - b. Review & Approval of O&M's (listed by Division)
 - c. Preparation of Warranties
 - d. Review & Approval of Warranties
 - e. Training & Demonstration activities
 - f. Attic Stock Transfer

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for the Notice of Award 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 separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
1. Activity Duration: Define Construction Activities so no activity is longer than fourteen (14) working days, unless specifically allowed by Owner and Designer.
 2. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 30 working days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 3. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Include selection process activities for finishes and products specified by allowances or specified to be selected during the sample review process. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
 4. Startup and Testing Time: Include not less than 15 days for startup and testing.
 5. Final Acceptance: Indicate completion in advance of date established for Final Acceptance and allow time for Designer's administrative procedures necessary for Final Acceptance.
 6. Punch List and Final Completion: Include not more than 60 days for completion of punch list items and final completion.
 7. Demonstration and Training: Training of Owner's personnel as indicated in Section 017700 "Closeout Procedures."
- 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. No constraints, aside from those specifically listed in the Contract Documents, are allowed.
1. Phasing: Arrange list of activities on schedule by phase.
 2. Work under More Than One Contract: Include a separate activity for each contract.
 3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 4. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 011116 "Work by Owner". Delivery dates indicated stipulate the earliest possible delivery date.
 5. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with other construction projects.
 - b. Examination periods.
 - c. Graduation.
 - d. Athletic Events (if applicable to the project).
 - e. Student Move-in & move-out (if applicable to the project).
 - f. Utility Outages.
 - g. Uninterruptible services.
 - h. Use of premises restrictions.
 - i. Provisions for future construction.
 - j. Seasonal variations or limitations.
 - k. Environmental control.
 6. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Subcontract awards.

- b. Submittals.
- c. Purchases.
- d. Mockups.
- e. Fabrication.
- f. Sample testing.
- g. Deliveries.
- h. Installation.
- i. Tests and inspections.
- j. Adjusting.
- k. Curing.
- l. Startup and placement into final use and operation.

7. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the milestones listed in Paragraph 1.7.B. of this Section.

D. Plan of Action and Recovery Schedule:

1. A Plan of Action and Recovery Schedule shall be prepared by the Contractor when any of the following occur:
 - a. The Contractor's report indicated delays that would prevent the Contractor's ability to complete the project within the Contract Duration.
 - b. The updated construction schedule is thirty (30) days behind schedule.
 - c. The Contractor desires to make changes to the sequence of work that are, in the opinion of the Owner or Design, major in nature.
2. The Plan of Action is due from the Contractor within two (2) calendar days of Owners written demand.
3. Recovery schedules are due from the Contractor within five (5) calendar days of Owners written demand.

E. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules. Coordinate with Designer regarding which project management software will be used on the Project. Contractor to provide Owner two (2) licensed copies of the scheduling software for the duration of the Project.

1. Allowable scheduling software's include Microsoft Project, Primavera P6, or another software approved by the Owner.
2. Smartsheets, Google Sheets, Microsoft Excel, or similar products shall not be used to prepare or update the project schedule.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

- A. General: Prepare network diagrams using AON (activity-on-node) format.
- B. Startup Network Diagram: Submit diagram within 14 days of date established for the Notice 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 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 Designer's approval of the schedule.
 2. All activities, except for "Project Start" and "Project Finish", must have at least one predecessor activity and at least one successor activity.
 3. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
 4. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 5. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Time.
- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the preliminary network diagram, prepare a skeleton network to identify probable critical paths.
1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Mobilization and demobilization.
 - c. Purchase of materials.
 - d. Delivery.
 - e. Fabrication.
 - f. Utility interruptions.
 - g. Installation.
 - h. Work by Owner that may affect or be affected by Contractor's activities.
 - i. Testing [and commissioning].
 - j. Punch list and final completion.
 - k. 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 or a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
 4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.

- a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
- E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall project schedule.
- F. Initial Issue of Schedule: Prepare initial network diagram from a list of straight "early start-total float" sort. 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. Immediately 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 revising the 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 monthly progress meeting.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At monthly intervals, or as requested by Owner, the Contractor shall update the project schedule to reflect actual construction

progress and activities. Issue schedule three (3) calendar days 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 Actual Completion percentage for each activity.
 4. Notify Owner and Designer a minimum of one week prior to issuance of updated schedule of all anticipated significant revisions to the Construction Schedule.
- B. Distribution: Distribute copies of approved schedule to Designer, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
1. Post electronic copies of the updated project schedule on the project website.
 2. Post copies in Project meeting rooms and temporary field offices.
 3. 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.
 4. Provide Owner electronic copy of updated schedule in Contractor's scheduling software format.

END OF SECTION 013216

SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for the following:

1. Preconstruction photographs.
2. Periodic construction photographs.
3. Utility Photographs.
4. Construction Time-Lapse Camera.

1.2 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.

1.3 INFORMATIONAL SUBMITTALS

- A. Key Plan: Fifteen (15) days after Notice to Proceed, 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 by uploading to web-based project software site and email to Designer & NC State Project Manager. Include copy of key plan indicating each photograph's location and direction.
 2. Identification: Provide the following information with each image description in web-based project software site:
 - a. Name of Project.
 - b. Name and contact information for photographer.
 - c. Name of Designer.
 - 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.

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 Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
- C. Metadata: Record accurate date and time from camera.

- D. File Names: Name media files with date, Project area and sequential numbering suffix.

1.5 CONSTRUCTION PHOTOGRAPHS

- A. Photographer & Quality: Construction photographs shall be taken by a member of the Contractors Supervisory team and shall not be blurry. In the event that drone photography is to be used, Contractor shall engage with, or retain, a qualified drone operator. All drone photography must be approved in advance with N.C. State.

- B. 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.

- C. Preconstruction Photographs: Before commencement of excavation or demolition, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Owner or Designer.

- 1. Flag excavation or demolition areas before taking construction photographs.
 - 2. Take a reasonably sufficient quantity of photographs to reasonably show existing conditions within and adjacent to project before starting the Work.
 - 3. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
 - 4. Failure to submit preconstruction photographs may result in delayed processing of the initial payment application.

- D. Post-Demolition Photographs: After completion of demolition, but before any new construction activities, take photographs of Project site and surrounding areas.

- E. Periodic Construction Photographs: Take a reasonably sufficient quantity of photographs 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.

- F. Final Completion Construction Photographs: Take a reasonably sufficient quantity of photographs after date of Substantial Completion for submission as Project Record Documents. Owner and Designer will inform photographer of desired vantage points.

1.6 UTILITY PHOTOGRAPHS

- A. In conjunction with survey's required for as-builts, as required by Section 017700 "Closeout Requirements", the following photographs need to be submitted by the Contractor to Owner within two weeks of the backfilling of utilities or completion of the associated construction task. Failure to take appropriate photographs will result in Contractor excavating the work at no addition cost to the Owner so that all photographs can be taken.

- B. The following outline lists the utilities to be located and the data to be collected. Photographs shall be at a minimum resolution of 2200 x 1700. Digital photographs can be submitted in TIFF, JPG, or RAW file formats. File naming shall be all lower case text. File naming shall be as follows: bldg#_ncsu project number_util_photo#.file extension.

For example: 135_201300001_util_1.jpg

1. Steam Tunnel and Lines
 - a. Provide digital photographs of the tunnel, piping and expansions areas.
2. Water Lines - (Domestic, Fire Main, Chilled, Hot Water, & Reuse Waterlines)
 - a. Provide digital photographs of bends and valves.
3. Electric and Communication Duct Banks and Direct Buried Conduit
 - a. Provide digital photographs of the tunnel and conduit configuration.
4. Storm and Sanitary Sewer
 - a. Provide digital photographs of structures.
5. Existing Utilities
 - a. Provide digital photographs of any crossings or conflict between new utilities and existing utilities.
6. Deliverables for Surveys
 - a. The subsurface location data and platting shall be continuous throughout the project.
 - b. All data and plats are due to NC State within two-weeks of the backfilling of utilities or completion of the associated construction task.

1.7 CONSTRUCTION WEBCAM

A. Construction Time-Lapse and Web Camera

1. Contractor shall provide a live feed camera with time-lapse capabilities along with stand, at location indicated by Owner for the duration of the project.
2. Camera Requirements:
 - a. Resolution of 24 megapixels or greater.
 - b. Adjustable optical zoom.
 - c. Onboard memory of 5 days of buffering and storage of images in event of power or data outage.
 - d. Remove storage and archiving of images every 10 minutes during the course of the Work.
 - e. Remove access by project team to both still images and automated time-lapse movies of entire Project duration.
 - f. Web-based interface allowing download and use of images by third party.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)



March 2025

NC State University
Design and Construction
NC State's Requirements

END OF SECTION 013233

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Submittal Schedule.
 - 2. Submittal Administrative Requirements
 - 3. Submittal Procedures regarding Submitting Shop Drawings, Product Data, Samples, and other submittals.
 - 4. Schedule of Required Division 01 Submittals and associated due dates. Submittals to be reviewed by Owner in addition to Designer.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Designer'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 Designer's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as informational submittals.
- C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.
- D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.3 SUBMITTAL SCHEDULE

- A. No less than fifteen (15) calendar days after Notice to Proceed, Contractors shall submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or modifications to submittals noted by the Designer and additional time for handling and reviewing submittals required by those corrections.
 - 1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 - 2. Initial Submittal: Submit concurrently with start-up construction schedule. Refer to Section 012900 "Payment Procedures" for requirements for submission of submittal schedule prior to application for payment. Minimum preliminary submittal shall include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 - 3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.

- a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
4. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal category: either Action or Informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Designer's final release or approval.
 - g. Scheduled dates for purchasing.
 - h. Scheduled dates for installation.
 - i. Activity or event number.
5. Designer reserves the right to withhold, in addition to retainage, 10 percent of each payment request until the submittal schedule is received and accepted by the Designer.

1.4 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. 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 Action and Informational submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 - a. Exception: Where samples for initial selection and samples for verification are both required, submit samples for verification after initial selection has been returned by Designer.
 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Designer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- B. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Designer's receipt of submittal. Designer will document on submittal the date of receipt. Submittals received by Designer after 1:00 p.m. will be considered as received the following working day. 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 twenty (20) calendar days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Designer will advise Contractor when a submittal being processed

must be delayed for coordination. Delaying submittals to facilitate coordination between submittals shall not constitute a delay of the Work nor shall it be the basis for an extension of time.

2. Sequential Review: Sequential review is a submittal that requires review by more than one design discipline. Where sequential review of submittals by Designer's consultants, Owner, or other parties is required, submittal schedule shall reflect sequential review. Sequential reviews are anticipated for, but not limited to, the following:
 - a. Division 03 Section[s]:
 - 1) "Cast-in-Place Concrete."
 - b. Division 04 Section[s]:
 - 1) "Unit Masonry."
 - c. Division 05 Section[s]:
 - 1) "Structural Steel Framing."
 - 2) "Steel Decking."
 - 3) "Cold-Formed Metal Framing."
 - 4) "Metal Fabrications."
 - 5) Stairs and Railings of each type.
 - d. Division 06 Section[s]:
 - 1) "Rough Carpentry."
 - 2) "Sheathing."
 - 3) "Interior and Exterior Architectural Millwork."
 - e. Division 07 Section[s]:
 - 1) "Joint Sealants."
 - f. Division 08 Section[s]:
 - 1) "Aluminum Framed Entrances and Storefronts."
 - 2) "All-Glass Entrances and Storefronts."
 - 3) "Glazed Aluminum Curtain Walls."
 - 4) "Metal Frames Skylights."
 - 5) "Door Hardware."
 - 6) "Louvers and Vents."
 - g. Division 14 Section[s]:
 - 1) "Electric Traction Elevators."
 - h. Facility Services Subgroup Divisions: All Sections.
 - i. Site and Infrastructure Subgroup Divisions: All Sections.
 - j. Process Equipment Subgroup Divisions: All Sections.
3. If intermediate submittal is necessary, process it in same manner as initial submittal.
4. Allow twenty (20) calendar days for review of each resubmittal.

- C. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
1. Assemble complete submittal package into a single indexed file with links enabling navigation to each item.
 - a. Unique identifier, including revision number. Submittals shall be numbered with the Section number, followed by a dash, followed by a three-digit number, followed by a dash, and ending with a sequential submission number as indicated below. The numbering system shall be retained throughout all revisions.
 - 1) Section Number: Section number where submittal is specified.
 - 2) Three-Digit Number: Sequential number, beginning with "001," for each submittal transmitted to Designer for each Section.
 - 3) Submission Number: Use "0" for initial submittal, "1" for first resubmittal, "2" for second resubmittal, and so forth.
 - 4) Example: 061000-001-0 (Section 061000, first submission of the Section, initial submittal).
 2. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Designer.
 3. Scanned Copies: Legible scanned PDF files of paper originals are acceptable. Scanned submittals that are not legible will be rejected.
 4. Sheet Orientation: Orient PDF sheets to a "Ready-to-Read" orientation with majority of text horizontal to the sheet with no additional adjustments or formatting required by the viewer.
 5. File Security: Do not set any permissions on the file. Protected documents will not be accepted.
 6. Transmittal Form for Electronic Submittals: Use PDF of completed Submittal Transmittal form in Document 00 60 00 "Project Forms."
 7. Metadata: Include the following information in the electronic submittal file metadata:
 - a. Title: Project title
 - b. Author: Contractor's name.
 - c. Subject: Submittal type (product data, shop drawing, report, etc.)
 - d. Keywords: Number and title of appropriate Specification Section; manufacturer name; product name/model number.
 8. File Transmission: Through project website. Do not transmit submittal via email.
- D. Options: Identify options requiring selection by Designer.
- E. Deviations and Additional Information: Deviations to the requirements of the Contract Documents must follow the Substitution Requirements described in Section 012500 "Substitution Requirements".
- F. 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 stamped with Designer's action stamp marked "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED."
 - G. 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.
 - H. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals with Designer's action stamp marked "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS AS NOTED."
 - I. The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been reviewed by Designer and returned to Contractor with Designer's action stamp marked "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS AS NOTED."
- 1.5 SCHEDULE OF DIVISION 01 SUBMITTALS AND ASSOCIATED DUE DATES
- A. Section 012500 "Substitution Procedure"
 1. Substitution Requests: As needed
 - B. Section 012600 "Contract Modification Procedure"
 1. Five Year Climatic Average: No less than Fifteen (15) Workdays prior to mobilization
 - C. Section 012900 "Payment Procedures"
 1. Schedule of Values: No less than Fifteen (15) working days prior to submission of initial Application for Payment
 - D. Section 013100 "Project Management & Coordination"
 1. Vendor & Subcontract List: due within fifteen (15) calendar days of Notice to Proceed.
 2. Key Personnel Names: due within fifteen (15) working days of mobilization.
 3. BIM Execution Plan and Schedule: due within fifteen (15) calendar days of Notice to Proceed.
 - E. Section 013200 "Construction Progress Documentation"
 1. Daily Construction Reports: due weekly, template due prior to mobilization
 2. Material Location Reports: due monthly
 3. Site Condition Reports: due within five (5) calendar days of discovery of differing conditions.
 4. Special Reports: due within five (5) calendar days of unusual event.
 - F. Section 013216 "Construction Progress Schedule"
 1. Contractor's Initial Construction Schedule: due within fifteen (15) calendar days of Notice to Proceed.
 2. Construction Finish Schedule: due at 80% project completion
 3. Construction Schedule Update Report: due monthly

- G. Section 013233 "Photographic Documentation"
 - 1. Key Plan: due within fifteen (15) calendar days of Notice to Proceed.
 - 2. Digital Photographs: due within three (3) calendar days of taking photographs.
- H. Section 013300 "Submittal Procedures"
 - 1. Submittal Schedule: due within fifteen (15) calendar days of Notice to Proceed.
- I. Section 013523 "NCSU Safety Requirements"
 - 1. Site Specific Safety Plan: due no fewer than fifteen (15) working days prior to mobilization.
 - 2. Crane Plan: due no fewer than fifty (50) working days prior to the crane mobilizing.
 - 3. Safety Reports: due monthly.
- J. Section 014000 "Quality Requirements"
 - 1. Contractor's Site-Specific Quality Program: due not less than five (5) working days prior to preconstruction conference.
 - 2. Schedule of Tests & Inspections: submit prior to initial payment application.
- K. Section 015000 "Temporary Facilities & Controls"
 - 1. Site Logistics Plan: due not less than five (5) working days prior to preconstruction conference. Updated not less than monthly during construction.
 - 2. Fire-Safety Plan: due not less than five (5) working days prior to preconstruction conference.
 - 3. .
- L. Section 015100 "Temporary Utilities"
 - 1. Implementation and Termination Schedule: due prior to mobilization.
- M. Section 015700 "Temporary Controls"
 - 1. Erosion & Sedimentation Control Reports: due weekly while Erosion & Sedimentation Control Plan in the Project Documents is active.
 - 2. Moisture & Mold Prevention Plan: due not less than five (5) working days prior to preconstruction conference.
 - 3. Dust & HVAC Control Plan: due not less than five (5) working days prior to preconstruction conference.
 - 4. Noise & Vibration Control Plan: due not less than five (5) working days prior to preconstruction conference
- N. Section 017419 "Construction Waste Management & Disposal"
 - 1. Waste Management Plan: Due within thirty (30) calendar days of Notice to Proceed.
- O. Section 017700 "Closeout"

1. Closeout Submittal Log: Due at 50% completion, as determined by the project schedule.
2. Contractor's Statement of Completion with Request for Designer's Inspection: Due no later than ten (10) working days prior to Request for Designer's Pre-Final Inspection.

P. Section 017846 "Maintenance Materials"

1. Schedule of Maintenance Material Items: Due within five (5) working days prior to requesting an inspection for Substantial Completion.
2. Maintenance Material Transmittal: Due at Substantial Completion.

1.6 SUBMITTALS TO BE REVIEWED BY NC STATE IN ADDITION TO DESIGNER

A. N.C. State reserves the right to review the following submittals:

1. Commissioning FTP
2. Lift Plan (if applicable)
3. Safety Plan
4. Training/Warranty
5. Masonry/Precast (Sample Panel)
6. Classroom Lectern
7. Lab Case Work
8. Office Case/Mill Work
9. Roofs
10. Hardware (Keying)
11. Colors (Outdoors)
12. Fume Hoods
13. Indoor Signs (Schedule)
14. Elevators
15. Fire Pumps
16. Fire Sprinkler System (SCO must also approve)
17. Air Compressors
18. Back Flow Preventers
19. Boilers
20. Water Meters
21. Valves
22. Air Handler Units
23. Chiller Water Chemicals
24. Chillers
25. Controls
26. Mechanical Pumps
27. Electrical Panels
28. Power Meters
29. Switch Gear/ Transformers
30. Emergency Generator
31. Audio Visual Systems
32. Fire Alarm System
33. Card Readers
34. Security Infrastructure
35. Telecommunications
36. Irrigation Systems
37. Landscaping

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
1. Post electronic submittals as PDF electronic files directly to Project Web site specifically established for Project. Do not post zipped files.
 - a. Designer will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
 2. Action Submittals: Submit electronic copies of each submittal, unless otherwise indicated. Designer will electronically return electronic copies. Mark up and retain one returned copy as a Project Record Document.
 3. Informational Submittals: Submit electronic copies of each submittal, unless otherwise indicated. Designer will not return copies.
 4. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 017700 "Closeout Procedures."
 5. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 6. Systems Submittals: Identify submittals for systems such as fire alarms and fire protection systems, on the transmittal and act upon the system singularly as a combined submittal. If resubmission is required, resubmit entire system submittal,
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's written recommendations.
 - c. Manufacturer's product specifications.
 - d. Standard color charts.
 - e. Mill reports.
 - f. Standard product operating and maintenance manuals.
 - g. Compliance with recognized trade association standards.
 - h. Compliance with recognized testing agency standards.
 - i. Application of testing agency labels and seals.
 - j. Notation of coordination requirements.
 - k. Availability and delivery time information.
 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams showing factory-installed wiring.
 - b. Printed performance curves.

- c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 - 5. Submit Product Data before or concurrent with Samples.
 - 6. Submit Product Data in the following format:
 - a. PDF electronic file.
- C. Shop Drawings: Prepare and submit Project-specific information, drawn accurately to scale. Do not reproduce, digitally or otherwise, the Contract Documents and submit as Shop Drawings. Do not use, copy or reproduce title blocks, dimensions, notes, keynotes, symbols schedules or details from Contract Drawings, digital or otherwise. Use of the Contract Drawings shall be limited to reproduction, digitally or otherwise, of the exterior wall layout, interior partition layout, grid lines, doors, and windows. Do not base Shop Drawings on standard printed data.
 - 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Fabrication and installation drawings.
 - c. Roughing-in and setting diagrams.
 - d. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
 - e. Shopwork manufacturing instructions.
 - f. Templates and patterns.
 - g. Schedules.
 - h. Design calculations.
 - i. Compliance with specified standards.
 - j. Notation of coordination requirements.
 - k. Notation of dimensions established by field measurement.
 - l. Relationship and attachment to adjoining construction clearly indicated.
 - m. Seal and signature of professional engineer if specified.
 - 2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than size of Contract Drawings.
 - 3. Submit Shop Drawings in the following format:
 - a. PDF electronic file.
 - 4. BIM File Incorporation: Develop and incorporate Shop Drawing files into Building Information Model established for Project.
 - a. Prepare Shop Drawings in the following format: Same digital data software program, version, and operating system as the original Drawings.
 - b. Refer to Section 013100 "Project Management and Coordination" for requirements for coordination drawings.
- D. Samples: Submit physical units of materials or products for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Prior to transmission of any samples, coordinate with Designer for determination of submittal review location, where samples are better reviewed on site in contractor's construction field office. Coordinate arrival of samples no less than weekly with Designer to provide advance notice of sample arrival for the following week.
2. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
3. Refer to individual Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation, and similar construction characteristics.
4. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of applicable Specification Section.
 - e. Specification paragraph number and generic name of each item.
5. Electronic Sample Submittal Requirements: Submit corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record. Submittals without digital photos, not submitted under the contractor's submittal, and without contractor's review stamp shall be returned without review. Criteria for acceptable photography:
 - a. Clear photo of material label. Clearly written labels or manufacturer's labels shall be acceptable.
 - b. Clear photo of label appended by the general contractor indicated for which material the product is being submitted. Utilize labels as found in the drawings on the finish legend wherever available. Utilize adhesive type labels that will not become loose with handling onsite, labeling with a marker or other easily read lettering when photographed.
 - c. Clear photos in well lit conditions without shading on the material to show visual characteristics. Where multiple corners, sides or transitions occur, provide additional photos showing different conditions.
 - d. Materials to be installed on the exterior of the building shall be photographed in natural sunlight to show visual characteristics. Labeling is not required to be photographed in natural light.
 - e. Sample photography for guidance will be provided by the Designer upon request.
6. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. This sample shall be held at the contractor's trailer on site, clearly labeled with the transmittal and stamped submittal, clarifying the use of the material in the project. Samples shall be required to be sorted and stored in a manner to be easily produced upon in person request. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.

- b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
7. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
- a. Number of Samples: Submit one full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line.
 - b. Designer will return submittal with options selected.
 - c. Refer to Electronic Submittal Requirements for associated photography requirements for all samples.
 - d. Refer to Disposition for on site storage and labeling requirements of all samples.
8. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from the same material to be used for the Work, cured and finished in manner specified, and physically identical with the 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:
 - 1) Submit two sets of Samples.
 - 2) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 3) Submit at least three sets of paired units that show approximate limits of variations if variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample.
 - 4) Refer to Electronic Submittal Requirements for associated photography requirements for all samples.
 - 5) Refer to Disposition for on site storage and labeling requirements of all samples.
 - b. Designer will retain one Sample set; remainder will be returned. Mark up and retain one returned physically periodically, as feasible. The primary documentation shall be the contractor's electronic submittal, with the contractor's photograph, which will be returned electronically, unless specifically requested by the Contractor. Contractor to retain one returned sample set as a Project record sample, readily available and clearly labeled for use on site.
9. Preparation: Mount, display, or package Samples in manner specified to facilitate review of qualities indicated. Prepare Samples to match Designer's sample where so indicated. Attach label on unexposed side that includes the following:

- a. Generic description of Sample.
 - b. Product name or name of manufacturer.
 - c. Sample source.
 - 10. Submit Samples for review of kind, color, pattern, and texture for a final check of these characteristics with other elements and for a comparison of these characteristics between final submittal and actual component as delivered and installed.
 - a. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 - b. Refer to individual Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation, and similar construction characteristics.
 - c. Refer to Electronic Submittal Requirements for associated photography requirements for all samples.
 - d. Refer to Disposition for on site storage and labeling requirements of all samples.
 - E. Product Schedule or List: Prepare and submit 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.
 - 5. Submit product schedule in the following format:
 - a. PDF electronic file.
 - F. Application for Payment and Schedule of Values: Comply with requirements specified in Section 012900 "Payment Procedures."
 - G. Coordination Drawing Submittals: Comply with requirements specified in Section 013100 "Project Management and Coordination."
 - H. Subcontract List: Prepare and submit a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Submit on the form included in Document 00 60 00 "Forms," "Subcontractors and Major Material Suppliers List."
 - 1. Submit subcontract list in the following format:
 - a. PDF electronic file.
 - I. Contractor's Construction Schedule: Comply with requirements specified in Section 013200 "Construction Progress Documentation" for action required.
 - J. Construction Photographs : Comply with requirements in Section 013216 "Construction Progress Schedule."
 - K. Daily Construction Reports: Comply with requirements specified in Section 013233
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"Photographic Documentation".

- L. Test and Inspection Reports and Schedule of Tests and Inspections
Submittals: Comply with requirements specified in Section 014000 "Quality Requirements."
- M. Certified Surveys: Comply with requirements specified in Section 017300 "Execution."
- N. Closeout Submittals: Comply with requirements specified in Section 017700 "Closeout Procedures."
- O. Operation and Maintenance Data: Submit written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Section 017823 "Operation and Maintenance Data."
- P. Qualification Data: Submit written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of Designers and owners, and other information specified.
- Q. Welding Certificates: Prepare and submit written certification that welding procedures and personnel comply with requirements. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.
- R. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements and, where required, where required, is authorized by manufacturer for this specific Project.
- S. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements. Include evidence of manufacturing experience where required.
- T. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements.
- U. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements.
- V. 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.
- W. 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.
- X. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - 1. Name of evaluation organization.

2. Date of evaluation.
 3. Time period when report is in effect.
 4. Product and manufacturers' names.
 5. Description of product.
 6. Test procedures and results.
 7. Limitations of use.
- Y. Preconstruction Test Reports: Prepare and 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.
- Z. Compatibility Test Reports: Prepare and submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- AA. Field Test Reports: Prepare and submit reports, written by a qualified testing agency, on testing agency's standard form, 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.
- BB. Manufacturer's Field Reports: Prepare and submit written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:
1. Name, address, and telephone number of factory-authorized service 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.
- CC. Manufacturer's Instructions: Submit written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:
1. Preparation of substrates.
 2. Required substrate tolerances.
 3. Sequence of installation or erection.
 4. Required installation tolerances.
 5. Required adjustments.
 6. Recommendations for cleaning and protection.
- DD. Insurance Certificates and Bonds: Prepare and submit written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.

- EE. Material Maintenance Submittals: Comply with requirements specified in individual Sections for quantity and disposition of delivery of extra stock.
- FF. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED-DESIGN SERVICES

- A. Refer to Section 013573 "Delegated Design Requirements" for requirements regarding Delegated Design.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Designer.
- B. Project Closeout and Maintenance/Material Submittals: Refer to requirements in Section 017700 "Closeout Procedures."
- C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, coordinated, checked, and approved for compliance with the Contract Documents.

3.2 DESIGNER'S ACTION

- A. General: Designer will not review submittals that have not been properly transmitted, reviewed by Contractor, or do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Designer will review submittal, make marks to indicate corrections or revisions required, and return it to Contractor. Designer will stamp each submittal with an action stamp as illustrated at the end of this Section, and will mark stamp appropriately to indicate action, as follows:
 - 1. "NO EXCEPTIONS TAKEN": No further review of Submittal required.
 - 2. "MAKE CORRECTIONS NOTED": Resubmittal not required unless Contractor cannot comply with corrections noted.": Incorporate corrections in Work. If Contractor cannot comply with corrections as noted, revise to respond to exceptions and resubmit.
 - 3. "REVISE AND RESUBMIT": Revise as noted and resubmit for further review.
 - 4. "REJECTED": Submittal not reviewed for reasons noted.
 - 5. "REVIEWED": Submittal was reviewed for record only.
- C. Informational Submittals: Designer will review each submittal and will not return it, or will return it if it does not comply with requirements. Designer will forward each submittal to appropriate party.

- D. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Designer.
- E. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- F. Submittals not required by the Contract Documents will not be reviewed and may be discarded or returned marked "NOT REVIEWED."
- G. Substitution items received as product data, shop drawing, or sample submittals required by individual Sections will be returned to Contractor without review. Comply with requirements in Section 012500 "Substitution Procedures" for submission of substitution request.

END OF SECTION 013300

SECTION 013523 – NCSU SAFETY REQUIREMENTS

1.0 Purpose

- A. The purpose of this guideline is to define NC State contractor safety requirements. This guideline is intended to be a supplement to the General Conditions of the contract.
- B. The Designer or Construction Manager shall incorporate this document into the Project Manual in its entirety.
- C. Contractors and subcontractors are responsible for the safety of their employees and all persons on and around a work site. Contractors are solely responsible for the development and implementation of their safety programs. This document does not relieve the duty and responsibility of contractors, subcontractors, their agents, employees, and other persons performing portions of the work on a project to comply with federal, state, and/or local laws or regulations that relate to work site safety.

2.0 Scope

- A. This document provides contractors with the University's specific requirements that must be incorporated into the contractor's Site-Specific Safety Plan. This document is not designed or intended to replace the contractor's safety program, nor to address every possible safety, environmental, or health hazard associated with the contractor's work. In the event that the contractor's safety program includes a requirement or practice that is more stringent than set forth herein, the more stringent shall be followed. This document does not relieve the contractor of this obligation to: (1) control the means and methods by which its employees and any subcontractors perform work, and (2) independently ascertain what health and safety practices are necessary for the performance of the work.
- B. No specific requirements herein shall be construed to limit, replace, or supersede applicable provisions of federal, state, or local laws or regulations. [Occupational Safety and Health Administration \(OSHA\) Regulations; Standard Number 29 CFR 1926](#) are the foundation of these Guidelines.
- C. Deliverables
 - 1. Competent Person Designation (see attached form) (4.0/C)
 - 2. Verification of OSHA 30 or OSHA 10 compliance, based on project requirements. (4.0/D/1/b)
 - 3. Contractor Site Specific Safety Plan (SSSP). (4.0/I)
 - 4. Summary of the Daily Safety Inspections documented as part of regular project meeting minutes. For projects bid through Construction Services summaries of Daily Safety Inspections will be documented as agreed upon at the pre-construction meeting. (4.0/F/1)
 - 5. Regular (min. monthly) Safety Reports. (4.0/F/2)
 - 6. Traffic Control Plans (when impact exists) (4.0/QQ/1)

3.0 Reference Materials

- A. The following reference materials are required to be available upon request at every job site:
1. OSHA Regulations published by NC Department of Labor (DOL) (Available at (800) NC-LABOR, <http://www.nclabor.com/pubs.htm>).
 2. Safety Data Sheets (SDS) for all chemical products the contractor has brought to the worksite.
 3. The written Safety Plan of the Contractor or Subcontractor.
 4. Site inspection documentation.
 5. Worksite employee training records.
 6. Mishap reports and investigations.

4.0 General Responsibilities

- A. The contractor must notify the NC State Project Manager in writing at least 10 days prior to:
1. Utilizing powder-actuated tools
 2. Starting operations that will produce excessive odor, dust, and noise affecting occupied buildings or work near air intakes
 3. Using a combustion engine indoors
 4. Using a mobile crane or tower crane (50-day notice is required)
 5. Breaking ground for an excavation or trench
 6. Using a laser
 7. Using any source of radioactive material
 8. Working with lead or asbestos-containing materials
 9. Performing energized electrical work
 10. Working on or near active underground utility infrastructure (steam, chilled water, natural gas, water, etc.)
 11. Entering electrical distribution assets

Violation of any safety, security, or environmental requirement may result in the permanent removal of the contractor or their employees from the NC State premises.

- B. Construction Management
1. The contractor is responsible for compliance with all federal, state, and local laws, regulations, standards, executive orders, etc. applicable in part or whole pertaining to the scope of work.
 2. Contractors are responsible for compliance with all applicable NC State safety practices, procedures, policies, standards, and requirements.
 3. Contractors are responsible for providing qualified and competent personnel to perform activities under the scope of work. Contractors must provide documentation of training prior to beginning work on-site.
 4. Contractors are responsible for ensuring that subcontractors, their agents,

employees, visitors, and other persons performing portions of the work on a project comply with federal, state, and/or local laws or regulations that relate to work site safety.

5. Contractors are responsible for ensuring that subcontractors are informed of and comply with all applicable requirements within the scope of work.

C. Competent Person Designation

1. Contractors shall designate a competent person for activities as specified in OSHA 29 CFR 1926. Such activities include, but are not limited to, the following activities, as applicable to the job:

- a. general provisions
- b. ionizing/non-ionizing radiation
- c. gases, vapors, fumes, mists, dust
- d. ventilation
- e. hazard communication
- f. lead
- g. asbestos
- h. personal protective equipment
- i. hearing conservation
- j. respiratory protection
- k. rigging and material handling equipment
- l. welding, cutting, brazing
- m. electrical
- n. scaffold
- o. fall protection
- p. cranes (overhead and mobile)
- q. motor vehicles and equipment
- r. excavations
- s. concrete and masonry
- t. steel erection
- u. demolition
- v. stairways and ladders
- w. toxic and hazardous substances.

2. OSHA 29 CFR 1926.32(f) "Competent person" means one who is capable of identifying existing and predictable hazards in the surroundings or working conditions that are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

D. Contractor Safety Personnel

1. Safety Representative

- a. For all projects contractors must designate a Safety Representative prior to the start of the project. The Safety Representative may be the Project Superintendent and is responsible for all safety concerns related to the construction operations.
- b. For formally contracted projects (>\$500k), the Safety Representative must have completed, at a minimum, an OSHA 30-hour Construction

Safety Course. For informally contracted projects (<\$500k), the Safety Representative must have completed, at a minimum, an OSHA 10-hour Construction Safety Course.

- c. The Safety Representative must actively monitor the job site for safety issues on a daily basis. The Safety Representative may have additional site duties outside the scope of safety; when the safety representative is not on the project site, a competent designee must be assigned to monitor safety on the site.

2. Safety Professional

- a. **When appropriate, the contractor shall provide a full-time safety professional assigned to the project. The duties of the full-time safety professional must be strictly limited to safety-related activities, with no additional job site duties.**
- b. Safety professionals must have one or more of the following credentials: a professional certification (beyond an OSHA 30-hour course), a college or professional degree related to safety and health, or significant previous experience and skills necessary to thoroughly understand the health and safety hazard and controls relevant to the project. The designation and adequacy of qualifications of the full-time safety professional shall be reviewed and accepted by the University prior to the commencement of the work.
- c. Project-specific requirements for a full-time safety professional will be addressed in the contract documents and discussed during the Pre-Bid Meeting.

E. Daily Pre-Job Meetings

- 1. A pre-job meeting (i.e. "Tailgate" or "toolbox" meeting) shall be held at the beginning of each work period (normally in the morning before leaving the yard or work staging area). The pre-job meeting should include a discussion of the scope of work to be completed, associated hazards, and means and methods to mitigate the hazards. The pre-job meeting must be led by the supervisor or other competent person.

F. Safety Inspections

- 1. Daily Inspections: The Contractor shall perform daily job inspections and correct any unsafe conditions or actions. A summary of these inspections will be reviewed as a portion of and captured in the minutes of the weekly Owner, Designer, and Contractor job meetings.
- 2. Monthly Inspections: For projects with a duration of more than one calendar month (4 weeks), the safety inspection must be documented and include, at a minimum, the name of the person performing the inspection, the date, a checklist of items observed, any identified safety concerns, and actions taken to address identified concerns.
- 3. University Project Visits: The NC State Project Manager, or another owner representative, may perform unscheduled visits to project sites to address adherence to the Contractor Safety Requirements or Site-Specific Safety

Plans. Any safety concerns identified will be reported to the responsible contractor for prompt mitigation.

- G. Mishap Reporting: All mishaps occurring on the project site must be investigated to determine causes and actions must be taken to prevent recurrence. Mishaps resulting in a recordable injury requiring medical treatment or damage to NC State property must be reported in writing to the NC State Project Manager as soon as possible but no later than 24 hours from occurrence; the Project Manager shall be notified immediately of mishaps resulting in life-threatening injury.
- H. The Contractor shall address safety concerns at regularly scheduled meetings with subcontractors.
 - 1. Contractor Site-Specific Safety Plan (SSSP) - The Contractor must develop and implement an SSSP. The SSSP is a comprehensive safety plan for his or her employees, which covers all aspects of onsite construction operations and activities associated with the contract. This plan must comply with all applicable health and safety regulations and any project-specific requirements. The SSSP must be submitted to, reviewed, and accepted by NC State before beginning any on-site work activities.
 - 2. As applicable to the project, these items must be included in the SSSP:
 - a. Scope of Work
 - b. Emergency Procedures
 - c. 24-hour emergency points of contact
 - d. Identification of Designated Competent On-Site Personnel (per OSHA requirements)
 - e. Designated On-Site Safety Personnel
 - f. Safety orientation program
 - g. Site logistics Plan: address public (student, faculty, staff, visitor) safety, traffic plan, equipment and lay-down areas, site security, dust containment, etc.
 - h. Minimum PPE requirements
 - i. Hazard Assessment (for defined project tasks) - include hazard identification and mitigation
 - j. Mishap reporting and investigation procedures
 - k. Safety inspection/audit procedures
 - l. Sub-contractor requirements

5.0 General Requirements

- A. Asbestos - If asbestos-containing materials are uncovered during construction, NC State must be notified immediately. Do not attempt to remove the material. Contractors shall comply with provisions of the [State Construction Office Asbestos Abatement Guidelines and Policies](#) and the [NC State Asbestos Management Plan](#).
 - 1. If asbestos-containing material is present in any building material and is in good condition (i.e. non-friable) and will not be disturbed during construction, the material may be left in place. If asbestos-containing material is disturbed during construction activities, then it shall be removed; removal shall be performed by appropriately qualified and accredited personnel and in accordance with federal, state, and local regulations.

- B. Compressed Gas Cylinders
 - 1. Compressed gas cylinders shall be properly used, stored, and maintained as per federal, state, and local requirements.
 - 2. Cylinders shall not be stored in a location in which they are subject to mobile equipment traffic (including vehicles) unless adequately protected.
- C. Confined Space Entry
 - 1. Contractors required to enter a confined space at NC State must have and implement a written confined space entry program in accordance with OSHA 1926 Subpart AA Confined Spaces in Construction or OSHA 1910.146 permit required confined spaces, as applicable.
 - 2. Controlling contractors (those with overall responsibility for construction at the work site) must ensure space entry coordination when more than one entity enters the space.
 - 3. Each contractor must have a competent person who will identify confined spaces associated with the scope of their work. Before entry into a permit-required confined space, contractors must obtain the following information from the controlling contractor (when there is no controlling contractor, the contractor will obtain the information from the NC State Project Manager):
 - a. The location of each known permit space associated with the project scope;
 - b. The known hazards or potential hazards that make it a permit space;
 - c. Any precautions needed to be taken based on the known hazards or potential hazards.
 - 4. Each contractor performing work in a permit space must perform a hazard assessment specific to the work to be performed and establish corresponding hazard controls.
 - 5. A competent person from each contractor performing work in a permit space must complete and sign [Appendix F](#) to the [NC State Confined Space Entry Program](#).
- D. Contaminated Soil - If soil or any materials appear to be contaminated, the NC State Project Manager must be notified immediately. The NC State Project Manager will contact NC State EHS for assistance at (919) 515-7915.
- E. Electrical Power Lines (Overhead) - The contractor shall have a trained and knowledgeable observer (signal person) within sight of the operator and the overhead lines that will effectively provide guidance and clearance information to the operator as the equipment may approach the minimum approach distances. Advising the operator shall be the signal person's one and only task. When conducting any work with a crane, derrick, or hoist in the vicinity of any overhead electric power transmission or distribution line, the contractor shall observe all clearance requirements dictated by all applicable OSHA rules, as specifically contained within 29 CFR 1910 - Standards for General Industry, CFR 1926 - Standards for Construction, IEEE C2 - NEC, NFPA 70 - NEC, the NCSBC, ANSI standards, and other applicable NC State safety guidelines and requirements. Further, no crane, derrick, or hoist operator or contractor shall conduct any operation at any distance closer than 20 feet to any electric power line lower than 200 kV or closer than 35 feet to any electric power transmission line at voltages higher than 200 kV and lower than 250 kV, unless the requirements of OSHA 1926 Sub CC for preventing encroachment/electrocution are strictly followed.
- F. Elevators/Material Hoists
 - 1. Any persons operating elevators/hoists must be trained to do so. Documentation

- shall be kept onsite.
- 2. No elevator/hoist with a defect shall be used.
- 3. Elevator/hoist safety devices shall not be overridden or made inoperable.
- G. Emergency Equipment- The following shall not be moved, blocked, disabled, or rendered inaccessible unless authorized by NC State:
 - 1. Fire equipment
 - 2. First aid equipment, fire blankets, stretchers, eyewash fountains, and safety showers
 - 3. Fire protection, hydrants, and detection systems
- H. Emergency Medical Treatment - To receive immediate assistance for emergency medical treatment call 911.
- I. Environmental and Chemical Requirements
 - 1. Contractors must provide NC State with a list of all chemicals to be used on NC State property and maintain a copy on-site of the SDS for each chemical prior to being brought on-site. Each chemical container must be labeled clearly with the identity of the chemical and any associated hazards in accordance with the OSHA Hazard Communication Standard (1910.1200).
 - 2. Contractors must follow the safety procedures recommended by the manufacturer or seller of any chemicals, tools, equipment, or other materials. Contractors are to remove all empty containers, excess chemicals, and chemical waste from NC State property.
 - 3. For all chemical incidents, contractors shall call 911 and also notify the NC State Project Manager.
- J. Excavation and Trenches - Before doing any excavation work, the Contractor must locate all utilities by calling the local utility locator service and NC State.
- K. Excavations
 - 1. Underground Facilities Locate. Contractors shall ensure underground installations and facilities are identified by calling 811 (Call Before You Dig) before performing any excavating activity. Note: excavation includes movement or removal of earth, rock, or other materials in or on the ground by use of manual or mechanized equipment. This is required for any project with earth-moving activities before you dig so that underground facilities can be identified and avoided. Detailed instructions and requirements can be found at nc811.org.
 - 2. Competent Person. Trench and excavation work must be performed under the direction of a competent person. Responsibilities include: classifying soil, inspecting protective systems, monitoring water removal, and conducting site inspections.
 - 3. Cave-In Protective Systems. A protective system is required by OSHA-1926 Subpart P for trenches and excavations that are 5 feet or more in-depth OR if the competent person has examined the ground and finds an indication of a potential cave-in. Protective systems typically include sloping/benching, shoring, or shielding. To determine what protective systems are appropriate, the competent person must first determine the soil type: Stable Rock, Type A, Type B, or Type C soil. Type C soil is the least cohesive and therefore, the least stable. No work shall be permitted in excavations where water has accumulated unless the integrity of the excavation has been protected.
 - 4. Excavations >20 feet in depth or that cannot comply with OSHA requirements require written approval by a Registered Professional Engineer (RPE).
 - 5. A ladder, stairway, ramp, or other means of access must be provided within the excavation when excavations are >4 feet in depth.

6. Barricades (stop-logs) shall be provided where vehicles or mobile equipment are used near or adjacent to excavations.
 7. Spoil piles must be placed a minimum of 2 feet from the edge of the excavation.
 8. Air monitoring must be performed if the excavation is >4 feet in depth and there is a potential for a hazardous atmosphere to exist.
- L. Exit Routes
1. Exit routes must be maintained at all times during construction.
 2. Lighting and marking must be adequate and appropriate.
 3. Exit routes must be kept free of explosive or highly flammable furnishings.
 4. Exit routes must be free and unobstructed. No materials or equipment may be placed, either permanently or temporarily, within the exit route. The exit access must not go through a room that can be locked, such as a bathroom, to reach an exit or exit discharge, nor may it lead into a dead-end corridor. Stairs or a ramp must be provided where the exit route is not substantially level. No materials shall be stored in a stairwell.
- M. Explosives: Blasting on university property is prohibited.
- N. Fall Prevention. A fall hazard is any condition on a walking-working surface that exposes an employee to a risk of a fall on the same level or to a lower level. Examples of fall hazards include, but are not limited to: floor openings, hoist areas, roofs, leading edges, scaffolding, ramps, etc.
1. Preventing or protecting falls from height may be necessary at any height given the circumstances, but is required when an employee is at a height of 6 feet or more above a lower level.
 2. Contractor work generally falls within construction industry applications, where acceptable methods depend on the type of work being performed: unprotected sides or edges, roof work, leading edge, etc. In all cases, contractors shall comply with the respective OSHA standards.
 3. Contractors shall ensure that every employee required to work at unprotected heights (greater than 6 feet) is trained in fall hazard recognition and prevention.
 4. **Guardrail System.** A guardrail system provides the highest level of protection and is always preferred. The system must be capable of supporting 200 lbs. in any direction and still maintain its integrity. The individual heights of the components must conform to the following minimum standards:
 - a. The top rail of the system must be at a height of 42" (+ or – 3");
 - b. the mid rail must be at a height of 21" with a 3" variation possible;
 - c. the toe board must have a minimum vertical height of 3.5".Note: The building code has more stringent requirements for permanent installations.
5. **Personal Fall Protection Systems.** At times, it is necessary to work in areas where guardrails cannot be constructed; in these instances, a personal fall protection system must be used. Personal Fall Protection Systems are systems (including all components) that provide protection from falling or that safely arrest a fall. Examples include travel restraint and personal fall arrest. All components of this system shall meet the applicable design requirements as specified in OSHA 1910, 1926, or ANSI Z359. All components shall be inspected by the wearer prior to each use and at least annually by a competent person. No employee may use a personal fall protection system without proper training and an understanding of proper use and safe application of the system.
- a. **Travel Restraint System.** A travel restraint system is a combination of an

anchorage, anchorage connector, lanyard (or other means of connection), and body support that the wearer uses to eliminate the possibility of going over the edge of a walking-working surface. Anchorages for travel restraint systems shall have a strength capable of sustaining static loads of at least 1,000 lbs. (per person) or two times the foreseeable forces for certified anchorages. Anchorage connectors, lanyards (or other means of connection), and body support devices shall be used in accordance with the manufacturer's requirements. The system shall be installed so that a fall cannot occur; therefore, a rescue plan is not required.

- b. **Personal Fall Arrest System.** A personal fall arrest system is a system used to safely arrest a user in a fall from a walking-working surface. It includes an anchorage, anchorage connector, and a full-body harness. The means of connection may include a lanyard, deceleration device, lifeline, or a suitable combination of these. Equipment must be worn and used in accordance with the manufacturer's requirements. Anchorages for personal fall arrest systems shall have a strength capable of sustaining static loads of at least 5,000 lbs. (per person) or two times the maximum arresting force for certified anchorages. The system shall be installed so that should a fall occur, the wearer will not contact the lower level or any other obstruction. Since there is a potential for a fall to occur, a rescue plan written by a qualified person is required.
- c. **Warning Line System.** A warning line may be used for construction roofing work when closer to the fall hazard than 15ft, but no closer than 6ft and in conjunction with one of the following: a guardrail system, a safety net system, a personal fall protection system, or a safety monitoring system. A warning line system shall conform to regulatory requirements and enclose all authorized employees conducting work protected by the Warning Line System. Refer to OSHA 1926.502(f).

O. Fire Protection and Prevention

- 1. The contractor shall be responsible for the development and maintenance of an effective fire protection and prevention program at the job site throughout all phases of the construction. Contractors shall perform inspections on fire extinguishers monthly. Contractors shall immediately replace fire extinguishers that do not pass inspection.
- 2. Fire cutoffs shall be retained in buildings undergoing alterations or demolition until operations necessitate their removal.
- 3. If work requires the disabling of Fire Protection Devices, then the Contractor must request a Fire Alarm Disconnect; through the appropriate NC State process; beginning with the Project Manager. No alarm shall be disabled at any time by the Contractor.

P. Hand and Power Tools

- 1. All hand and power tools and similar equipment, whether furnished by the employer or the employee, shall be maintained in a safe condition. Any tool found not in proper working order, or that develops a defect during use, shall be immediately removed from service and not used until properly repaired.
- 2. All tools shall be used, operated, and maintained in accordance with OSHA and manufacturer requirements.

Q. Hot Work Permits - A Hot Work Permit is required when any indoor or outdoor work will involve hot work, defined as operations including cutting, welding, thermite welding, brazing, soldering, grinding, thermal spraying, thawing pipe, installation of

torch-applied roof systems or other similar activities. Requirements for Contractors performing this work are contained in the NC State Hot Work Permit Program which is a part of the specifications package and can also be found in the [Hot Work Permit Form](#).

R. Housekeeping

1. The Contractor must maintain a clean and orderly project job site. The Contractor shall maintain NC State's pathways free of rocks, mud, and other miscellaneous construction debris. The Contractor shall prevent the accumulation of dirt, dust, and/or other debris on NC State's roadways. The Contractor shall clean the travelways on a daily basis. (Refer to project specifications for requirements.)
2. Waste material and debris must be removed from the work and access areas at least once a day. Waste material and debris should not be thrown from one level to another but should be carried down, lowered in containers, or deposited in a disposal chute.
3. Materials must be neatly piled, stacked, or otherwise stored to prevent tipping or collapsing. Materials must be carefully stacked and located so they do not block aisles, doors, fire extinguishers, safety showers, eyewash stations, fixed ladders, or stairways.
4. Material to be lifted by crane or other hoisting devices must not be stored under overhead power lines.
5. No materials may be stored on penthouses, roofs, or other areas until a specific area is assigned by NC State for a specific project.
6. Adverse Weather: If NC State becomes aware of an adverse weather event, the NC State Project Manager shall notify the construction superintendent, and the contractor shall perform a job site review to ensure any debris or construction materials are secured and protected from the elements.

S. Illumination - Construction areas, ramps, runways, corridors, offices, shops, and storage areas shall be lit to not less than the minimum illumination intensities required by OSHA.

T. Ladders - All ladders must meet OSHA requirements.

U. Lasers

1. Lasers must comply with the OSHA Construction Industry Standards.
2. Lasers must be low-power (<5mw) devices with visible beams. Lasers to be used must bear a label indicating this maximum power output. Lasers that do not bear this label shall not be used.
3. "Laser in use" signs shall be posted according to OSHA requirements.
4. Lasers must be used in a manner that will not risk exposure to others.

V. Lead

1. Lead may be found in certain painted surfaces. A check for lead presence should be conducted prior to certain activities such as grinding, sanding, or burning over painted surfaces. If lead-containing paint is disturbed or a material is questionable the NC State Project Manager must be notified immediately. Do not attempt to remove the material.
2. Hot Work over lead-painted surfaces is generally not permitted.

W. Lock Out/Tag Out

1. All contractors that work on energized equipment with any hazardous energy source are required to have a hazardous energy control (i.e. lockout tagout) program. The program shall specify policies and procedures for de-energizing, verifying de-energizing, and securing the source potential using energy isolating devices and applying locks/tags or implementing other forms of hazardous

energy control as specified in OSHA standards. Types of potential energy sources include, but are not limited to:

- a. Electrical (refer to the section of these requirements titled "Electrical")
 - b. Pneumatic
 - c. Hydraulic
 - d. Thermal
 - e. Kinetic (motion)
 - f. Hazardous gas, liquid, air
 - g. Radiation
 - h. Lasers
2. When multiple contractors are performing work on the same project, hazardous energy control procedures shall be coordinated by the controlling entity which includes establishing device standardization.
 3. Contractors shall ensure site personnel are trained on the hazardous energy control program.
 4. Central [Utility Plant \(CUP\) - Lockout Tagout Procedure](#)
 - a. Contractors with the need to perform LOTO operations within the operating CUP shall be trained in accordance with the procedure and comply with applicable sections of the procedure. The contractor is responsible for providing this training; a copy of this procedure will be provided to the contractor.
 - b. Contractor management shall ensure that authorized personnel are assigned to perform work in which they are qualified.
 - c. Contractor management shall comply with applicable sections of the procedure.
- X. Mobile Cranes, Tower Cranes, etc. (Reference OSHA 1926 Subpart CC).
1. Prior to the setup or operation of any crane on university property, the NC State Project Manager (or another point of contact) shall be notified; notification must be made with as much lead time as possible, but no fewer than fifty (50) working days
 2. Cranes shall be set up and operated in compliance with the manufacturer and applicable OSHA requirements.
 3. Contractors are responsible for ensuring ground conditions are capable of supporting the equipment and load, which will include performing underground facilities/utilities location (i.e. 811 calls) as well as factual confirmation of necessary compaction capacities. This confirmation is to be by third-party inspection services, at the expense of the contractor.
 4. No lifts may occur over occupied spaces unless a registered structural engineer evaluates and certifies that the building can withstand the impact of a load being dropped on the building as a worst-case scenario. If it is determined that the building cannot withstand the impact without compromising the structure, areas of the building within the load fall zone must be evacuated during the duration of the lift. This evacuation process must be a part of the lift plan and managed by the contractor.
 5. The crane contractor shall provide equipment documentation, including the annual inspection and the last monthly inspection. Documentation must be signed.
 6. Crane operators shall be certified by an Accredited Crane Operator Certification Agency for the type of equipment operated. Examples of such agencies, include, but are not limited to:

- a. National Commission for the Certification of Crane Operators (NCCCO)
- b. National Center for Construction Education and Research (NCCER)
- c. Operating Engineers Certification Program (OECF)
- d. Electrical Industry Certifications Association (EICA)

Additionally, the crane operator's employer must attest that the operator was evaluated to verify the operator demonstrates skills and knowledge to safely operate the equipment as well as the ability to recognize and avert risk, as required under 29 CFR1926.1427 (f).

- 7. All rigging personnel and signal persons shall be qualified in accordance with OSHA 1926 Subpart CC.
- 8. Crane Lift Plan. A lift plan is required for any lift in a location not under the exclusive control of the contractor, including lifts affecting NC State property, structures, employees, students, or visitors. Each lift plan must be developed by a qualified person and include at least the following:
 - a. The identity of the controlling entity, meaning the employer with the overall responsibility for construction operations associated with the crane lift.
 - b. Identify a lift director (i.e. primary signal person) and method of communication (hand signals, radio, etc.).
 - c. Contractors conducting crane operations are required to obtain required FAA permits according to 14 CFR Part 77; to be submitted with the lift plan.
 - d. Equipment positioning locations, including load staging and movement and paths to and from the working position.
 - e. Equipment specifications including load and reach capacities.
 - f. Current qualifications, certifications, and licenses of operators and riggers.
 - g. For lifts involving more than one crane, the lift plan shall encompass all cranes.
 - h. Fall Zone: The contractor shall identify the Fall Zone. The Fall Zone is the area (including but not limited to the area directly beneath the load) in which it is reasonably foreseeable that partially or completely suspended materials could fall. Spaces within the Fall Zone (including buildings, foot traffic, vehicle traffic, etc.) shall be barricaded to control access. The Fall Zone shall be cleared of personnel not participating in the lift.
 - i. Wind limitations.
 - j. Ground and subsurface stability at crane and load placement locations. The contractor must ensure a qualified person evaluates the crane set-up location to ensure ground conditions are sufficient. (See X., 3. above).
 - k. Other conditions or factors that may affect the safety of the lift.
 - l. A pre-lift meeting must be completed immediately before the lift and shall include all personnel involved with the lift and a thorough review of the elements and specifics of the lift plan and personnel assignments.
 - m. Specify the distance to the closest energized lines and the applicable minimum approach distance of any lift component.
 - n. Where items positioned by a crane lift are rigged at heights above easy reach height, the lift plan shall include safe attachment and de-attachment

procedures and the control of exposure to fall hazards.

- o. The contractor must provide documentation of annual and monthly inspections for the previous 3 months. 1926.1412(f) & .1412(e).

Y. Electrical

1. Electrical Contractor shall ensure that their personnel using electrically powered equipment are trained to recognize electrical hazards, inspect and maintain electrically powered equipment, and on safe work procedures to prevent exposure to electric shock.
2. Premises Electrical Equipment. All electrical installations must comply with the National Electrical Code® (NEC®). Work associated with electrical equipment installed in accordance with the NEC® will be conducted in accordance with the NFPA 70E® Standard for Electrical Safety in the Workplace. NC State's goal is to minimize exposure to shock and arc flash hazards during the installation, repair, maintenance, and operation of electrical equipment, components, and systems.
 - a. Electrical power sources shall be de-energized, verified, and locked out prior to working on electrical equipment except when de-energization creates a greater hazard and a properly executed Energized Electrical Work Permit (EWP) has been completed.
 - b. Contractors performing electrical work must have their own energized electrical work program that includes a permit process.
3. Power Generation & Distribution: Work by Qualified Persons and Unqualified Persons working on or near power generation or distribution equipment is addressed in OSHA 29CFR1910.269. It includes work on or directly associated with installations used for the generation, control, transformation, transmission, and distribution of electricity. Any work involving the NC State distribution system shall be coordinated by the NC State Project Manager (or other university contact person) in collaboration with the Facilities Division Power Systems group.
 - a. Work involving the NC State electrical distribution system shall only be performed after authorization by the Facilities Division Power Systems group in accordance with the Power Systems Switching Procedure.
 - b. System Check-In/Out: Prior to entering any primary enclosure (substation, transformer, manhole, switch, switching station, etc.) of the NC State Power System the NC State Project Manager or other designated person shall send a text or email to group-powersystementry@ncsu.edu with the work location and brief description of the tasks to be performed (photos are welcomed). When exiting the enclosure, check out with NC State Power Systems using the same method. This is only for unescorted access. For example, if you're with a member of the Power Systems team there's no need to check in/out, but if that team member has to leave your work site, you're expected to check in and check out.
4. The contractor will follow all requirements as noted in NFPA 70E.

Z. Mobile Elevating Work Platforms (MEWPs)

1. General Requirements.
 - a. MEWPs shall be operated in accordance with the manufacturer's requirements and specifications.
 - b. Employees must always stand firmly on the floor of the MEWP and must not sit or climb on the edge of guardrails, or use planks, ladders, or other devices for a work position. The guardrail system of the platform must not

- be used to support materials, other work platforms, or employees.
- c. A personal fall arrest/restraint system shall be used in accordance with the manufacturer's requirements. A scissor lift with approved guardrails may be used without a personal fall arrest system when specified by the manufacturer, however, if there are designated anchor points, the use of a fall arrest/restraint system is required.
 - d. The MEWP must be used only in accordance with the manufacturer's operating instructions and safety rules.
 - e. The designed rated capacity for a given angle of elevation must not be exceeded.
 - f. At least 10 ft distance must be maintained away from overhead power lines with a nominal voltage of 50kV or less; 20 ft for power lines over 50kV (or if the voltage is unknown). Note: qualified workers using appropriately insulated MEWPs may approach closer than 10 ft when following provisions specified in OSHA 1910.268, 1910.269, and 1926 Subpart V, as applicable.
 - g. The manufacturer's rated load capacity must not be exceeded. The load and its distribution on the platform must be in accordance with the manufacturer's specifications. The rated load capacity must not be exceeded when loads are transferred to the platform at elevated heights. Only employees, their tools, and necessary materials must be on or in the platform.
 - h. A trained spotter with no other job duties is required when a MEWP is driven; the spotter will assess conditions that could pose a hazard to the operation (for example, drop-offs, holes, slopes, inadequate surface and support, obstructions, pedestrians, vehicles, debris, electric lines, etc.) and stop operations and alert the operator. The operator shall halt operations until hazards are adequately controlled.
2. Training
- a. Only personnel who have received training to operate the specific type(s) of MEWPs are authorized to operate them on NC State property.
 - b. Training must include inspection, application, and operation of MEWPs (including recognition and avoiding hazards associated with their operation). Operators are only authorized to use MEWPs of the specific model for which they are trained and evaluated.
 - c. Training must be provided by a person who has knowledge regarding the laws, regulations, safe use practices, manufacturer's requirements, and recognition and avoidance of hazards, and is familiar with the specific type(s) of MEWPs. Note: Personnel may not operate rented equipment unless qualified to operate the specific equipment; the rental provider or other authorized evaluator must provide familiarization training to satisfy this requirement.
3. Inspection, Maintenance, and Testing
- a. Each MEWP must be inspected, maintained, repaired, and kept in proper working condition in accordance with the manufacturer's operating or maintenance and repair manual or manuals. Maintenance inspections shall be completed at intervals no less frequent than annually.
 - b. Before use, visual equipment inspections and a functional check must be performed before each shift in accordance with the manufacturer's operating manual. Any MEWP found not to be in a safe operating

condition must be removed from service until repaired. All repairs must be made by an authorized person in accordance with the manufacturer's operating or maintenance and repair manual or manuals.

- c. Before and during use, visual worksite inspections must be performed and include workplace risk assessment. The workplace risk assessment includes identifying and evaluating hazards (for example, drop-offs, holes, slopes, inadequate surface and support, obstructions, pedestrians, vehicles, debris, electric lines, etc.) and establishing effective control measures. Uncontrolled hazardous situations must be corrected prior to the initial or continued use of the MEWP.

AA. Noise/Vibration

1. Noise-producing equipment, such as power drills, jackhammers, welders, etc., can create sound levels of 80dB(A) or greater in and around a construction area. Notify the NC State Project Manager in advance to determine the appropriate times to operate high noise/vibration equipment for that project's location.
2. Appropriate personal protective equipment shall be used when working around high-noise/vibration equipment.

BB. Overhead Work

1. Work must not be performed above other personnel, including other contractor employees. Affected areas must be roped off or barricaded and marked to prohibit traffic.
2. Contractors must not climb on the heating and air-conditioning ductwork, plumbing steam piping, sprinkler piping, electrical cable trays, fixtures, or furniture or use as work platforms.
3. Contractors are expected to comply with OSHA fall protection requirements.

CC. Paints and Solvents - Contractors must provide the following safeguards:

1. Adequate ventilation must be maintained at all times when paints or solvents are being used. Refer to [NC State Odor Prevention and Dust Control in Occupied Buildings](#) for additional information.
2. Contractor personnel must use proper respiratory protection and protective clothing when the toxicity of the material requires such protection.
3. Flammable solvents and materials must be used with extreme caution when possible sources of ignition exist.
4. Flammable paints and solvents must be stored in an approved flammable liquid storage cabinet when storage is required inside buildings. Acids and flammables must never be stored together. If an approved flammable liquid storage cabinet is not available, flammable paints and solvents must be removed from the building.
5. Flammable liquids must be dispensed in a safety can with a flash screen bearing a Factory Mutual or Underwriters Laboratory (UL) approval.

DD. Personal Protective Clothing and Equipment - The contractor shall determine this minimum level of protective equipment to be worn on the job site (example: hard hat, eye protection, safety vest, gloves, and safety shoes); NC State expects contractors to conform to industry accepted minimum PPE standards, for example, hard hats, safety glasses, and protective toe footwear. Any additional safety equipment required by a specific activity shall also be worn and shall meet or exceed OSHA standards. This applies to ALL persons entering the job site.

EE. Powder-Actuated Tools

1. Powder-actuated tools are not to be used on NC State property unless specific approval is obtained from NC State prior to usage.
2. If approved, powder-actuated tools must be used in accordance with OSHA and

manufacturer regulations.

FF. Power Vehicle Equipment

1. Only trained operators are allowed to use power vehicles on NC State property. Contractor management will be expected to provide proof of training if requested.
2. Generally, LP gas-powered trucks are not to be used inside NC State buildings. Prior approval from NC State is required.
3. The design of the LP gas-fueled industrial truck for use within NC State buildings must comply with the following:
 - a. LP gas-fueled industrial trucks must comply with NFPA 505-1982.
 - b. If trucks are in continuous use in a populated area, they must be equipped with a catalytic converter.
 - c. LP gas containers must not exceed the nominal 45 pounds of LP gas.
4. The following conditions and requirements will govern the use of LP gas-fueled vehicles inside the confines of NC State buildings and structures:
 - a. LP gas-fueled trucks must be removed from the building and parked at the end of each workday and not left unattended while in use. When the job requiring the vehicle is complete, the vehicle must be removed from the job site.
 - b. Trucks and tanks must not be refueled inside buildings.
 - c. All areas where LP gas-fueled trucks are used must be well ventilated.
5. All LP cylinders must be stored outside and secured by a chain in an upright position.

GG. Roof Safety

1. The contractor shall request authorization from NC State prior to accessing a roof.
2. During all rooftop operations, the contractor must provide fall protection measures in accordance with OSHA.
3. A Hot Work Permit and at least two appropriate fire extinguishers of the correct ABC type are required when performing hot work on roofs. Other persons acting as a Fire Watch shall be in place on the roof and on the floor(s) directly below the operation.

HH. Sanitation

1. Drinking Water - An adequate supply of water, meeting the U.S. Public Health Service Drinking Water Standards, shall be provided.
2. Washing Facilities
 - a. The contractor shall provide adequate washing facilities for employees engaged in the application of paints, coating, herbicides, or insecticides, or in other operations where contaminants may be harmful to the employees. Such facilities shall be close to the work site and shall be so equipped as to enable employees to remove such substances.
 - b. Hand soap or similar cleansing agents shall be provided.
 - c. Individual hand towels, cloth or paper, warm air blowers, or clean individual sections of continuous cloth toweling, shall be provided.
3. Toilet facilities shall be provided for employees according to OSHA requirements.

II. Scaffolding

1. The contractor shall erect, use, and dismantle scaffolding in accordance with OSHA and manufacturer regulations.
2. Competent Person. Scaffolds must be erected and dismantled under the direction of a competent person. Responsibilities include, but are not limited to:
 - a. supervise and direct scaffold erection, moving, dismantling, or alteration.

- b. determine the feasibility and safety of providing fall protection for employees erecting or dismantling supported scaffolds. Employers are required to provide fall protection for employees erecting or dismantling supported scaffolds where the installation and use of such protection is feasible and does not create a greater hazard.
 - c. inspect scaffold and scaffold components for visible defects before each work shift and after any occurrence that could affect a scaffold's structural integrity and ensure identified deficiencies are corrected,
 - d. determine if it is safe for employees to work on scaffolds during storms or high winds.
 - 3. Access. When scaffold platforms are more than 2 feet (0.6 m) above or below a point of access, portable ladders, hook-on ladders, attachable ladders, stair towers (scaffold stairways/towers), stairway-type ladders (such as ladder stands), ramps, walkways, integral prefabricated scaffold access, or direct access from another scaffold, structure, personnel hoist, or similar surface shall be used. Cross Braces shall not be used as a means of access.
 - 4. Fall Protection. Each employee on a scaffold more than 10 feet (3.1 m) above a lower level shall be protected from falling to that lower level; each employee on a suspended scaffold shall be protected by a personal fall arrest system attached to an independent anchorage.
 - 5. Falling Object Protection. Where the potential for tools, materials, or other equipment could fall from a scaffold, the area below must be barricaded, and personnel not permitted to enter the area OR effective means shall be implemented to prevent objects from falling.
- JJ. Signs, Tags, and Barricades (references 1926 Sub G and ANSI Z535)
 - 1. Signs and Tags: Each sign and tag must include a signal word, symbol, and text.
 - a. Signal words:
 - (1) DANGER = the hazard will most likely result in serious injury or death;
 - (2) WARNING = the hazard could result in serious injury or death;
 - (3) CAUTION = the hazard would not likely result in serious injury or death;
 - (4) NOTICE = indicates important information, but is not directly hazard-related.Symbols or graphics are used to bridge language barriers and draw attention to the message.
 - b. Text is used to convey the safety message in a clear, concise manner.
 - 2. Barricades. Barricades must be installed for situations where a physical obstruction is necessary to deter the passage of people, vehicles, or equipment. When used, barricades must be installed at all points of access.
 - a. Barricades associated with traffic control in a public roadway must comply with the Federal Manual of Uniform Traffic Control Devices and the North Carolina Supplement. Coordinate with the NC State Transportation Office.
 - b. Barricades may take many forms on construction sites, but when used, they must clearly indicate the intent of the barricade. All barricades are required to include a sign that includes the name of the person responsible for the barricaded area, method for contacting the responsible person (ex. phone number), and clear and concise text describing the purpose of the barricade.

(1) CAUTION Tape Barricades should be used when the hazardous condition is not likely to cause serious physical harm but could result in injury. Standard CAUTION Tape must be used, which includes yellow tape with the word "CAUTION" in black letters. Personnel may enter the barricaded area only when implementing precautions to address the identified hazard.

(2) DANGER Tape Barricades are used when a serious or imminent danger may exist. Standard DANGER Tape must be used, which includes red tape with the word "DANGER" in black letters. Only personnel specifically authorized by the person responsible for the barricaded area may enter the barricaded area.

- KK. Silica (Respirable Crystalline Silica) – The following requirements apply to all operations involving exposure to respirable crystalline silica. Examples of such operations include: cutting, grinding, drilling, or crushing brick, block, concrete, stone, rock, mortar, and other materials that contain crystalline silica.
1. Contractors shall comply with OSHA standard 29 CFR 1926.1153 including taking all necessary steps to comply with the established exposure limits.
 2. Contractors must have a written Exposure Control Plan specific to their operations in accordance with 29 CFR 1926.1153 that includes specific details for controlling exposure to NC State personnel and the public. A copy of this plan shall be made available to NC State EHS and/or the university Project Manager upon request.
 3. Tasks performed indoors or in an enclosed area shall have effective exhaust ventilation to minimize the accumulation of visible airborne dust. In situations where ventilation is exhausted in an area with the potential to expose people to dust must incorporate effective HEPA filtration; such areas include but are not limited to, inside a building or outside where people may be present.
 4. When a building ventilation system services an area where work with the potential for generating respirable crystalline silica exists, the building air returns shall be blanked or closed while such work is in progress. Contractors must coordinate this with the university project manager.
 5. Contractors must establish a "Temporary Restricted Area" for tasks that require the use of respiratory protection in accordance with 29 CFR 1926.1153.
 - a. A *Temporary Restricted Area* is an area demarcated by the employer where an employee is required to wear respiratory protection.
 - b. *Temporary Restricted Areas* must be designated with signs, barriers, or other effective means that will ensure unauthorized persons do not enter.

If such work is performed in *occupied* buildings, dust barriers shall be installed as necessary to isolate the restricted area. Refer to [NC State Odor Prevention and Dust Control in Occupied Buildings](#) for additional information.

- LL. Smoking and Open Flames
1. Smoking is not allowed in any NC State buildings, including roofs, penthouses, electrical/mechanical rooms, and basements or within 25 feet of any building entrance or exit.
 2. The use of open flames is strictly prohibited in areas where flammable liquids, gasses, or highly combustible materials are stored, handled, or processed.
 3. The use of open flames, where allowed, requires a Hot Work Permit.

- MM. Tarpaulins - When tarpaulins are required for the deflection of hot slag, dust, paint drippings, etc., or as a security barrier, they must be flame resistant and in good condition, free of holes and worn edges.
- NN. Tar Pots (tar kettles) - Tar Pots are not allowed on roofs. The contractor must notify the NC State Project Manager prior to using tar pots and obtain a Hot Work permit.
- OO. Temporary Heating - When heaters are used in confined spaces, special care shall be taken to provide sufficient ventilation to ensure proper combustion, maintain the health and safety of workmen, and limit temperature rise in the area.
- PP. Temporary Lighting - The contractor shall submit a lighting plan for night work, underground work, and any other worksites without adequate lighting.
- QQ. Temporary Traffic Control
 - 1. All traffic control shall be approved by NC State and meet the Institute for Transportation Research and Education (ITRE) Work Zone Safety Guidelines for Construction, Maintenance, and Utility Operations. A traffic control plan shall be provided by the contractor and approved prior to commencement.
 - 2. The contractor shall provide warning signs, barriers, barricades, etc., in accordance with the construction plans and specifications or whenever such protection is needed.
 - 3. Where signs and barricades do not provide adequate protection, particularly along a road, walkway, or main aisle, flagmen shall be used.
 - 4. Review with the crew, each person's responsibility regarding the traffic control set-up (e.g. sign installation, lane closure setup, etc.).
 - 5. Review traffic control devices to be used at the site. Assure that traffic control set-up is properly installed. The installer shall document what traffic control set-up was used (including the sign types and sign locations) and how it was installed.
- RR. Vehicle Operation
 - 1. All equipment shall have operational backup alarms. Equipment shall not be utilized until such device is functioning properly.
 - 2. All vehicles shall be operated in accordance with OSHA and manufacturer regulations.
- SS. Vertical Lifts - All contractors' platforms or vertical lifts must meet OSHA and manufacturer requirements.

SECTION 013573 – DELEGATED DESIGN REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Administrative and procedural requirements for portions of the Work the design of which is delegated to the Contractor.

1.2 REFERENCES

- A. Abbreviations and Acronyms:

- 1. AHJ: Authority Having Jurisdiction.
 - 2. SCO: State Construction Office

- B. Definitions:

- 1. Delegated: Means transferred by the Designer to the Contractor.
 - 2. Design: Means the complete planning, arrangement, and coordination of a discrete portion of the work, along with its graphic and written communication, including determination and engineering of its organization and structure in response to aesthetic requirements, functional requirements, dimensional and geometric limits, and the arrangement, performance, and other criterion indicated in the Contract Documents.
 - 3. Engineering Services: Means structural engineering services performed for the design, fabrication, and installation of systems, assemblies, and components similar in material, design, complexity and extent to that indicated for the delegated design portion of the Work.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Portions of the Contract Documents may delegate the design of discrete portions of the Work to the Contractor, or may otherwise specify "delegated design requirements" in individual specification Sections. Part 3 of this Section describes the portions of work that have been delegated to the Contractor.
- B. The Contractor is professionally liable for delegated design work, including design, engineering, and conformance to specified performance requirements.
- C. Drawings of delegated design portions of the Work are diagrammatic; they do not identify or imply solutions to engineering aspects of the portions of the Work that are required to be designed by the Contractor, and are intended to only indicate:
 - 1. The design intent of final profiles, shapes and forms of the specified materials;
 - 2. Relationships between adjacent components of the Work;
 - 3. Location, identification, dimension and size of components, assemblies, accessories, and other components of the Work; and
 - 4. Schematic joining and attachment details and diagrams of fasteners and connections.
- D. Specifications for delegated design portions of the Work are performance based, and establish the minimum qualities and performance criteria for materials, fabrications, products, systems, assemblies, and methods of execution.

- E. The Designer reviews and determines whether or not the Contractor's proposed delegated design work:
 - 1. Conforms to the design intent of the delegated design portion of the Work being reviewed;
 - 2. Conforms to the specified graphic and specification requirements, including subsequent modifications; and
 - 3. Is appropriately integrated into the adjacent components of the Work and, where applicable, the overall design of the project.
- F. In the event of a dispute regarding the Contractor's proposed delegated design solutions and the design intent of the Contract Documents, the decision of the Designer is final.

1.4 PROCEDURAL REQUIREMENTS

- A. Design Requirements: Proposed delegated design solutions shall demonstrate conformance to the original design intent of the Contract Documents, as determined by the Designer.
 - 1. Unless otherwise defined by the Contract Documents, the appearance of exposed elements, including member sizes, profiles, and alignment of components shall be within the dimensional limits and section profiles indicated, and consistent throughout the Project where the delegated design component of the Work is to be installed.
 - 2. Deviation from the profiles, layouts, dimensional locations, or arrangements indicated is not permitted without prior written consent from the Designer.
 - 3. Deviations from the specifications are not permitted without prior written consent from the Designer.
 - 4. Contractor-proposed delegated design solutions that exactly follow the details indicated on the Drawings do not relieve the Contractor from liability for the design, fabrication, and performance of the delegated design portions of the Work.
- B. Engineering Requirements: Engineer delegated design portions of the Work shall;
 - 1. Meet or exceed the specified performance performance and quality requirements;
 - 2. Conform to the dimensional and graphic requirements of the Drawings;
 - 3. Satisfy the requirements of the AHJ; and
 - 4. Provide structurally sound, leak-proof, non-corroding, and weather tight applicable, the minimum specified in-service loads, and thermal, seismic, and wind sway, or other types of movement, without incipient or catastrophic failure.
- C. Regulatory Requirements: Delegated design items shall be engineered in conformance with the North Carolina State Building Code and the City of Raleigh.
- D. SCO Review: Once a Designer has approved the Delegated Design Submittal conforms with the overall design intent, the Designer shall upload the Delegated Design Submittal into Interscope for SCO review and comment. All SCO Comments must be incorporated into the submittal. SCO approval of the submittals must occur prior to starting any work associated with the Delegated Design Submittal on the project.

1.5 SUBMITTALS

- A. General: Coordinate and process submittals for delegated design portions of Work in same manner as for other portions of Work.
- B. Professional Engineer's qualifications.
- C. Design Data: Submit structural engineering calculations demonstrating conformance to the requirements of the Contract Documents and of the AHJ.
 - 1. Calculations must be legible and incorporate sufficient cross-references to shop drawings to make calculations readily understandable and reviewable.
 - 2. At a minimum, structural calculations must contain:
 - a. An analysis of framing members;
 - b. Section property computations for framing members;
 - c. An analysis of anchors, including anchors embedded in concrete;
 - d. The signature and seal of the professional structural engineer, licensed in the state of North Carolina, and responsible for their preparation.
 - 3. Test reports are not an acceptable substitute for calculations.

1.6 QUALITY ASSURANCE

- A. Professional Structural Engineer's Qualifications: Must be legally licensed or otherwise qualified to practice in the state of North Carolina.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide materials, fabrications, products, components, and accessories required for a complete installation, whether or not such items are indicated on the Drawings or in the Specifications.
- B. Provide anchors, attachments, inserts, fasteners, clips, bracing, framework, and similar items as required to meet specified design and performance requirements, and to securely attach delegated design Work to adjacent supports, or to adjoining work, whether or not such items are indicated on the Drawings or in the Specifications.

PART 3 - EXECUTION

3.1 DESIGN

- A. Unless otherwise indicated or specified, maintain the design intent and conform to the performance requirements indicated on the Drawings and in the Specifications, as determined by the Designer.
 - 1. In the interest of fabrication or erection methods, minor dimensional changes and detailing adjustments to the original design communicated in the Contract Documents may become necessary.
 - 2. Obtain written approval from the Designer for proposed changes and

adjustments before procurement, fabrication, manufacture, assembly, or installation, as applicable.

- B. Engage a qualified professional structural engineer to design connection details and determine fastener types and sizes.
 - 1. Fasteners or connections may neither conflict with nor require revision to the finish profiles indicated or the supporting work.
 - 2. Connections may not impose eccentric loading, nor induce twisting or warping to the supporting structure.
 - 3. Connections must be designed to accommodate potential and actual misalignment of adjacent work within tolerances specified in other Sections.

3.2 DELEGATED DESIGN SCHEDULE

- A. The following sections have been preapproved as being allowed by the State Construction Office for delegated design and are included in this project:
 - 1. Steel Stairs / Handrails

END OF SECTION 013573

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, Commissioning Authority or authorities having jurisdiction are not limited by provisions of this Section.
 - 4. Specific test and inspection requirements are not specified in this Section.

1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
 - 1. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes, doors, windows, millwork, casework, specialties, furnishings and equipment, and lighting.

- D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- F. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.
- G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
 - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

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

1.5 ACTION SUBMITTALS

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

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data : For Contractor's quality-control personnel.
- B. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- C. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Entity responsible for performing tests and inspections.
 - 3. Description of test and inspection.
 - 4. Identification of applicable standards.
 - 5. Identification of test and inspection methods.
 - 6. Number of tests and inspections required.
 - 7. Time schedule or time span for tests and inspections.
 - 8. Requirements for obtaining samples.
 - 9. Unique characteristics of each quality-control service.

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.
- B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
 - 1. Project quality-control manager may also serve as Project superintendent.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
 - 1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
 - 2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
 - 3. Owner-performed tests and inspections indicated in the Contract Documents, including tests and inspections indicated to be performed by the Commissioning Authority.
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.

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

1.8 REPORTS AND DOCUMENTS

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

payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.9 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
 - 1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329 and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
 - 1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 - 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and Accreditation Program 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 laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
 - e. When testing is complete, remove test specimens, assemblies, and mockups, do not reuse products on Project.
 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect and Commissioning Authority, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
 2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
 3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at Project.
 4. Demonstrate the proposed range of aesthetic effects and workmanship.
 5. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
 - a. Allow seven days for initial review and each re-review of each mockup.
 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 7. Demolish and remove mockups when directed unless otherwise indicated.

1.10 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 2. 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 Section 013300 "Submittal Procedures."
- D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- F. Testing Agency Responsibilities: Cooperate with Architect, Commissioning Authority and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect, Commissioning Authority 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

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

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 014339 – MOCKUPS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for mockups as required by the project manual.
- B. Related Requirements: Refer to applicable sections of the Specifications for materials, products and components to be included in mockups.

1.2 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.

1.3 DEFINITIONS

- A. Mockups: Full-size physical assemblies that are constructed on-site, unless indicated otherwise. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

1.4 ACTION SUBMITTALS

- A. Shop Drawings, In-Situ: For in-situ mockups, submit a markup of the plans to show where the mockup area will be located.

1.5 QUALITY ASSURANCE

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

- B. Exterior Mockups: Construct exterior mockup according to approved Shop Drawings and with location as indicated on Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials.

1. Engineering for mockup structural support and foundation is by Contractor.

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

1. Review requirements for construction of mockups, and for protecting and maintaining mockups.
2. Review procedures for reviewing, changing, and approval of mockups.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014339

SECTION 015000 - TEMPORARY FACILITIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes requirements for support facilities, and security and protection facilities.
 - 1. Provide and maintain all temporary facilities and controls necessary for the performance of the Work. Locate and install all facilities and controls where acceptable to the local authorities having jurisdiction and utility owner and remove same and terminate, in a manner suitable to the utility owner, at completion of the Work or when otherwise directed. Pay all costs associated with the provision and maintenance of temporary facilities and controls including power, water, and fuel (if any) consumed until Substantial Completion.
 - 2. Notwithstanding these specifications for Temporary Facilities and Controls, the incorporation of all temporary facilities and controls into the Project shall be subject to the Owner's approval.
- B. Related Sections include the following:
 - 1. Section 013300 "Submittal Procedures" for procedures for submitting copies of implementation and termination schedule and utility reports.
 - 2. Section 015100 "Temporary Utilities" for requirements associated with temporary utilities.
 - 3. Section 015639 "Temporary Tree & Plant Protection" for requirements associated with protection of trees & plants.
 - 4. Section 015700 "Temporary Controls" for control requirements.
 - 5. Section 017300 "Execution" for progress cleaning requirements.
 - 6. Section 017419 "Construction Waste Management and Disposal" for waste management requirements.
 - 7. Section 017700 "Closeout Procedures" for closeout requirements.
 - 8. Divisions 02 through 49 for temporary heat, ventilation, and humidity requirements for products in those Sections.

1.2 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.

1.3 DEFINITIONS

- A. Permanent Enclosure: As determined by Designer, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

1.4 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities are not chargeable to Owner or Designer and 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, the following:

1. Owner's personnel.
2. Owner's construction forces.
3. Designers.
4. Commissioning Authority.
5. Testing agencies.
6. Personnel of authorities having jurisdiction.

1.5 INFORMATIONAL SUBMITTALS

- A. Site Logistics Plan: Using the Site Plan from the Drawings as a base, prepare and maintain a detailed logistics plan showing, at a minimum: temporary facilities, fencing, signage, utility hookups, staging areas, and parking areas for construction personnel. Additional sheets, including markup on interior sheets, or sheets wholly prepared by the Contractor, may be required to reasonably convey the current logistics plan for the project.
1. Submit initial Site Logistics Plan not less than five (5) working days prior to preconstruction conference.
 2. Update Site Logistics Plan as site conditions evolve during progress of the work, but not less than monthly.
- B. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
1. Submit Fire Safety Program not less than five (5) working days prior to preconstruction conference.

1.6 QUALITY ASSURANCE

- A. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines, and ICC/ANSI A117.1.

1.7 PROJECT CONDITIONS

- A. Conditions of Use: The following conditions apply to use of temporary facilities by all parties engaged in the Work:
1. Keep temporary facilities clean and neat.
 2. Relocate temporary facilities as required by progress of the Work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide materials suitable for use intended.
- B. Pavement: Comply with paving Sections.
- C. Lumber and Plywood: Comply with requirements in Section 061053 "Miscellaneous Rough Carpentry."

- D. Gypsum Board: Minimum 1/2 inch thick by 48 inches wide by maximum available lengths; regular-type panels with tapered edges. Comply with ASTM C 36.
- E. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indices of 25 and 50, respectively.
- F. 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.
- G. Tarpaulins: Fire-resistive labeled with flame-spread rating of 15 or less.
- H. Dust-Control Adhesive-Surface Walk-off Mats: Provide mats minimum 36 by 60 inches.
- I. Water: Potable.

2.2 TEMPORARY FACILITIES

- A. Field Offices: Prefabricated or mobile units with lockable entrances, operable windows, and serviceable finishes; heated and air conditioned; on foundations adequate for normal loading.
- B. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
 - 1. Store combustible materials apart from building.

2.3 EQUIPMENT

- A. Fire Extinguishers: Hand carried, portable, UL rated. Provide class and extinguishing agent as indicated or a combination of extinguishers of NFPA-recommended classes for exposures.
 - 1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.
- B. Self-Contained Toilet Units: Single-occupant units of chemical, aerated recirculation or combustion type; vented; fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.
- C. Drinking-Water Fixtures: Containerized, tap-dispenser, bottled-water drinking-water units, including paper cup supply.
 - 1. Where power is accessible, provide electric water coolers to maintain dispensed water temperature at 45 to 55 deg F.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.
 - 1. Locate facilities to limit site disturbance as specified in Section 011400

"Work Restrictions."

- B. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

- 1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
- 2. Maintain support facilities until Designer schedules Final Inspection. Remove before Final Acceptance. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Field Office

- 1. Provide an insulated, weather tight temporary field office for use by Contractor, Designer, and Owner. Field office shall have not less than two office spaces, a conference room, and toilet facilities with running water.
 - a. Provide each office space with a desk, desk chair, and two side chairs.
 - b. Provide each conference room with a conference table, seating for not less than 12 people, and appropriate audiovisual technology to support virtual and or hybrid meetings.
 - c. Furnish, maintain, and pay for light, power, phone, internet, wi-fi and other field office services.
 - d. For the Owner's exclusive use during the project, provide one (1) 12" wi-fi only Apple iPad Pro tablet computers of the latest model with a minimum 128gb memory, including protective cases with keyboard and stylus with each, with the Contractor's tracking and punchlist software installed.
 - e. Provide Owner with two (2) office adjacent temporary parking spaces for Owner personnel.

C. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

D. Lifts and Hoists: Provide facilities for hoisting materials and personnel. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

E. Existing Elevator Use: Use of Owner's existing elevators will be permitted, provided elevators are cleaned and maintained in a condition acceptable to Owner. At Final Acceptance, restore elevators to condition existing before initial use, including replacing worn cables, guide shoes, and similar items of limited life.

- 1. Do not load elevators beyond their rated weight capacity.
- 2. Provide protective coverings, barriers, devices, signs, or other procedures to protect elevator car and entrance doors and frame. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work so no evidence remains of correction

work. Return items that cannot be refinished in field to the shop, make required repairs and refinish entire unit, or provide new units as required.

- F. Existing Stairs: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Final Acceptance, restore stairs to condition existing before initial use.
 - 1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.

3.3 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects
 - 1. Comply with work restrictions specified in Section 011400 "Work Restrictions."
- C. Barricades, Warning Signs, and Lights: Comply with authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting. Paint with appropriate colors and graphics to inform personnel and public of possible hazard.
- D. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- E. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is not complete, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
 - 2. Vertical Openings: Close openings of 25 sq. ft. or less with plywood or similar materials.
 - 3. Horizontal Openings: Close openings in floor or roof decks and horizontal surfaces with load-bearing construction.
 - 4. Install tarpaulins securely using fire-retardant-treated wood framing and other materials.
 - 5. Where temporary wood or plywood enclosure exceeds 100 sq. ft. in area, use fire-retardant-treated material for framing and main sheathing.
- F. Temporary Partitions: Provide and maintain floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner and tenants from fumes and noise.
 - 1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant plywood on construction side of stud

framing.

2. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
 3. Insulate partitions to control noise transmission to occupied areas.
 4. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
 5. Protect air-handling equipment.
 6. Provide walk-off mats at each entrance through temporary partition.
- G. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
1. Prohibit smoking in construction area.
 2. Provide fire extinguishers, installed on walls on mounting brackets, visible and accessible from space being served, with sign mounted above.
 - a. Field Offices: Class A stored-pressure water-type extinguishers.
 - b. Other Locations: Class ABC dry-chemical extinguishers or a combination of extinguishers of NFPA-recommended classes for exposures.
 - c. Locate fire extinguishers where convenient and effective for their intended purpose; provide not less than one extinguisher on each floor at or near each usable stairwell.
 3. Store combustible materials in containers in fire-safe locations.
 4. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for firefighting.
 5. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition.
 6. Permanent Fire Protection: At earliest feasible date in each area of Project, complete installation of permanent fire-protection facility, including connected services, and place into operation and use. Instruct key personnel on use of facilities. Protect fire protection system from damage due to construction activities and environmental conditions.
 7. Develop and supervise an overall fire-prevention and first-aid fire-protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
 8. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.
- H. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Final Acceptance. Perform control operations lawfully, using environmentally safe materials.
- I. Termite Control: By Owner. Contractor to provide ten (10) working days notice prior to the treatment being required.

3.4 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. Protect from damage caused by freezing temperatures and similar elements.
 - 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.
 - 2. Prevent water-filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.
- C. Temporary Facility Changeover: Except for using permanent fire protection as soon as available, do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than 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 the property of Contractor. Owner reserves right to take possession of Project identification signs.
 - 2. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
 - 3. At Substantial Completion, repair, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements in Section 017700 "Closeout Procedures."

END OF SECTION 015000

SECTION 015100 - TEMPORARY UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes requirements for temporary utilities.
 - 1. Provide and maintain all temporary utilities necessary for the performance of the Work. Locate and install all utilities where acceptable to the local authorities having jurisdiction and utility owner and remove same and terminate, in a manner suitable to the utility owner, at completion of the Work or when otherwise directed. Pay all costs associated with the provision and maintenance of temporary facilities and controls including power, water, and fuel (if any) consumed until Substantial Completion.
 - 2. Notwithstanding these specifications for Temporary Utilities, the incorporation of all temporary utilities into the Project shall be subject to the Owner's approval.
- B. Related Sections include the following:
 - 1. Section 013300 "Submittal Procedures" for procedures for submitting copies of implementation and termination schedule and utility reports.
 - 2. Section 015000 "Temporary Facilities and Controls" for requirements associated with temporary facilities.
 - 3. Section 017300 "Execution" for progress cleaning requirements.
 - 4. Section 017419 "Construction Waste Management and Disposal" for waste management requirements.
 - 5. Section 017700 "Closeout Procedures" for closeout requirements.
 - 6. Section 313116 "Termite Control" for pest control.
 - 7. Divisions 02 through 49 for temporary heat, ventilation, and humidity requirements for products in those Sections.

1.2 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.

1.3 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities are not chargeable to Owner or Designer and shall be included in the Contract Sum, unless otherwise indicated. Allow other entities to use temporary services without cost, including, but not limited to, the following:
 - 1. Owner's personnel.
 - 2. Owner's construction forces.
 - 3. Designers.
 - 4. Commissioning Authority.
 - 5. Testing agencies.
 - 6. Personnel of authorities having jurisdiction.
- B. Sewer Service: No sewer service use charge by Contractor, paid for by Owner. Contractor responsible for hookup and disconnect.

- C. Water Service: No water service use charge by Contractor, paid for by Owner. Contractor responsible for hookup and disconnect.
- D. Electric Power Service: No electric power service use charge by Contractor, paid for by Owner. Contractor responsible for hookup and disconnect.
- E. Internet Service: Owner does not allow Contractor to connect to university internet service. Contractor is responsible for providing internet service in all temporary facilities.

1.4 INFORMATIONAL SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.
- B. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- C. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.
 - 1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
 - 2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
 - 3. 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.
- D. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:
 - 1. Locations of dust-control partitions at each phase of work.
 - 2. HVAC system isolation schematic drawing.
 - 3. Location of proposed air-filtration system discharge.
 - 4. Waste handling procedures.
 - 5. Other dust-control measures.

1.5 QUALITY ASSURANCE

- A. Standards: Comply with ANSI A10.6, NECA's "Temporary Electrical Facilities," and NFPA 241.
 - 1. 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.

1.6 PROJECT CONDITIONS

- A. Temporary Utilities: At earliest feasible time, when acceptable to Owner, change over from use of temporary service to use of permanent service.
 - 1. Temporary Use of Permanent Utilities: Installer of each permanent service shall 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.
- B. Conditions of Use: The following conditions apply to use of temporary services by all parties engaged in the Work:
 - 1. Keep temporary services clean and neat.
 - 2. Relocate temporary services as required by progress of the Work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide materials suitable for use intended.

2.2 EQUIPMENT

- A. Electrical Outlets: Properly configured, NEMA-polarized outlets to prevent insertion of 110- to 120-V plugs into higher-voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light.
- B. Power Distribution System Circuits: Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125-V ac, 20-A rating, and lighting circuits may be nonmetallic sheathed cable.
- C. Temporary HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
- D. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction after dust generating activities in areas serviced by the system are complete, provide filter with MERV of 8 at each return air grille in system and remove at end of construction and clean HVAC system as required in Section 017700 "Closeout Procedures."
 - 1. Warranty period for the HVAC system begins at Final Acceptance, not the date in which the unit was started up.
 - 2. Contractor is responsible for a full duct cleaning and filter changes prior to Final Acceptance.

PART 3 - EXECUTION

3.1 TEMPORARY UTILITY INSTALLATION

- A. General: Engage appropriate local utility company to install temporary service or connect to existing service. Where utility company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with utility company recommendations.
1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
 2. Provide adequate capacity at each stage of construction. Before temporary utility is available, provide trucked-in services.
- B. Sewers and Drainage: If sewers are available, provide temporary connections to remove effluent that can be discharged lawfully. If sewers are not available or cannot be used, provide drainage ditches, dry wells, stabilization ponds, and similar facilities. If neither sewers nor drainage facilities can be lawfully used for discharge of effluent, provide containers to remove and dispose of effluent off-site in a lawful manner.
1. Filter out excessive soil, construction debris, chemicals, oils, and similar contaminants that might clog sewers or pollute waterways before discharge.
 2. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.
 3. Maintain temporary sewers and drainage facilities in a clean, sanitary condition. After heavy use, restore normal conditions promptly.
 4. Provide temporary filter beds, settlement tanks, separators, and similar devices to purify effluent to levels acceptable to authorities having jurisdiction.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction until permanent water service is in use. Sterilize temporary water piping before use.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking-water for use of construction personnel. Comply with regulations and health codes for type, number, location, operation, and maintenance of fixtures and facilities.
1. Disposable Supplies: Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Maintain adequate supply. Provide covered waste containers for disposal of used material.
 2. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy. Provide separate facilities for male and female personnel.
 - a. Drinking-Water Facilities: Provide bottled-water or drinking-water units. Ensure dispensed water temperature is between 45 to 55 deg F.
- E. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment from that specified that will not have a harmful effect on completed installations or elements being installed.
1. Maintain a minimum temperature of 50 deg F in permanently enclosed

portions of building for normal construction activities, and 65 deg F for finishing activities and areas where finished Work has been installed.

- F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
 - 1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.
- G. Electric Power Service: Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period. Include meters, transformers, overload-protected disconnecting means, automatic ground-fault interrupters, and main distribution switchgear.
 - 1. Install electric power service underground, unless overhead service must be used.
 - 2. Install power distribution wiring overhead and rise vertically where least exposed to damage.
- H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

END OF SECTION 015100

SECTION 015500 – VEHICULAR ACCESS & PARKING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes requirements for vehicular access and parking.
- B. Related Sections include the following:
 - 1. Section 015000 "Temporary Facilities" for requirements associated with temporary facilities.

1.2 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.

PART 2 – PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SUPPORT FACILITIES INSTALLATION

- A. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate to support loads and to withstand exposure to traffic during construction period. 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.
- B. Temporary Use of Permanent Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate to support loads and to withstand exposure to traffic during construction period. Locate temporary roads and paved areas in same location as permanent roads and paved areas. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
 - 1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
 - 2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Section 312000 "Earth Moving."
 - 3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
- C. Traffic Controls: Provide temporary traffic controls at junction of temporary roads with public roads. Include warning signs for public traffic and "STOP" signs for entrance onto public roads. 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. Pedestrian Detours: Sidewalks shall remain open and accessible during construction. Should sidewalks require closure, an accessible and safe temporary (concrete, asphalt or plywood) pedestrian path around construction shall be required if an alternative accessible route is not close by. Temporary paths shall be shown on the contract documents clearly showing path and type of construction.
- E. Parking: Use designated areas of Owner's existing parking areas for construction personnel.

END OF SECTION 015500

SECTION 015626 - TEMPORARY FENCING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes requirements temporary fencing.
 - 1. Provide and maintain all temporary fencing necessary for the performance of the Work.
- B. Related Sections include the following:
 - 1. Section 015000 "Temporary Facilities" for requirements associated with temporary facilities.

1.2 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.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide materials suitable for use intended.
- B. 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 continuous top and bottom rails. Provide one of the following bases for supporting posts.
 - 1. Water Filled Jersey Barriers
 - 2. Concrete Jersey Barriers
 - 3. Fence Panels with feet that need to be weighted down with concrete or sand.
 - 4. Poured concrete footings
- C. Wind Screening: An integral visual barrier or shading type material applied and maintained for the duration of the project. Wind Screening is only allowed on fences with poured concrete footings.

PART 3 - EXECUTION

3.1 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Site Enclosure Fence: Prior to commencing earthwork, install site enclosure fence as shown on plans with lockable entrance swing gates. Install in a manner that will prevent people, dogs, and other animals from easily entering site except by entrance gates.
 - 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.

2. Provide gates in sizes and at locations necessary to accommodate delivery vehicles and other construction operations.
 3. Maintain security by limiting number of keys and restricting distribution to authorized personnel.
- B. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.
- C. Locks: Locks for all gates or enclosures shall be interlocked with a padlock provided by NCSU in order to allow access by NCSU or other emergency personnel in case of emergency.

END OF SECTION 015626

SECTION 015700 - TEMPORARY CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes requirements for support facilities, and security and protection facilities.
 - 1. Provide and maintain all temporary facilities and controls necessary for the performance of the Work. Locate and install all facilities and controls where acceptable to the local authorities having jurisdiction and utility owner and remove same and terminate, in a manner suitable to the utility owner, at completion of the Work or when otherwise directed. Pay all costs associated with the provision and maintenance of temporary facilities and controls including power, water, and fuel (if any) consumed until Substantial Completion.
 - 2. Notwithstanding these specifications for Temporary Facilities and Controls, the incorporation of all temporary facilities and controls into the Project shall be subject to the Owner's approval.
- B. Related Sections include the following:
 - 1. Section 013300 "Submittal Procedures" for procedures for submitting copies of implementation and termination schedule and utility reports.
 - 2. Section 015100 "Temporary Utilities" for requirements associated with temporary utilities.

1.2 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.

1.3 INFORMATIONAL SUBMITTALS

- A. Moisture-Protection Plan: Not less than five (5) working days prior to preconstruction conference, Contractor shall submit a Moisture Protection plan Describing procedures and controls for protecting materials and construction from water absorption and damage.
 - 1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
 - 2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
 - 3. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, bathroom waterproofing testing, 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.
- B. Dust- and HVAC-Control Plan: Not less than five (5) working days prior to preconstruction conference, submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and

proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:

1. Locations of dust-control partitions at each phase of work.
2. HVAC system isolation schematic drawing.
3. Location of proposed air-filtration system discharge.
4. Waste handling procedures.
5. Other dust-control measures.

- C. Noise & Vibration Control Plan: Not less than five (5) working days prior to preconstruction conference, submit a Noise & Vibration Control Plan describing procedures and controls for protecting adjacent classrooms, laboratories, dormitories, common areas, and food service areas from excess noise and vibration. Pay special attention to exam and graduation periods. Include a description of how the Contractor will mitigate the following:

1. Vibration resulting from site preparation activities that could impact active experiments or student learning.
2. Noise resulting from shooting hangers, drywall tracks, or other components into floor below active classrooms.
3. Saw cutting and grinding activities.
4. Equipment noise.

PART 2 – PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SUPPORT FACILITIES INSTALLATION

- A. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction and in applicable Division 31 Sections for temporary drainage and dewatering facilities and operations not directly associated with construction activities included in individual Sections. Where feasible, use same facilities. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining property nor endanger permanent Work or temporary facilities.
2. Before connection and operation of permanent drainage piping system, provide temporary drainage where roofing or similar waterproof deck construction is completed.
3. Remove snow and ice as required to minimize accumulations.

3.2 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings.

1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant- protection zones.
2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.

4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- B. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

3.3 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. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 2. Use permanent HVAC system to control humidity.
 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
 - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective.
 - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Designer.
 - c. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

END OF SECTION 015700

SECTION 015800 – PROJECT IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes requirements for project identification.
- B. Related Sections include the following:
 - 1. Section 015000 "Temporary Facilities" for requirements associated with temporary utilities.

1.2 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.

PART 2 – PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PROJECT SIGNS

- A. Project Signs: Project signs are not allowed. Directional signs for material deliveries are allowed within the construction area, if required, and shall be 4' wide x 2' high maximum, black and white only. The NCSU Project Manager shall approve the design of the sign and the sign text.

END OF SECTION 015800

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes general 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.
- B. Related Sections include the following:
 - 1. Section 013100 "Project Management and Coordination" for procedures for coordinating field engineering with other construction activities.
 - 2. Section 013300 "Submittal Procedures" for submitting surveys.
 - 3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.2 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.

1.3 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.

1.6 QUALITY ASSURANCE

- 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, notify Designer of locations and details of cutting and await directions from Designer 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. Other construction elements include but are not limited to the following:
 - a. Water, moisture, or vapor barriers.
 - b. Membranes and flashings.
 - c. Exterior curtain-wall construction.
 - d. Sprayed fire-resistive material.
 - e. Equipment supports.
 - f. Piping, ductwork, vessels, and equipment.
 - g. Noise- and vibration-control elements and systems.
 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 Designer'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 products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: 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 Designer for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.
 1. While a subsurface utility exploration has been completed during the design phase and has been incorporated into the Drawings, before beginning construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.
 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. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 1. Description of the Work.
 2. List of detrimental conditions, including substrates.
 3. List of unacceptable installation tolerances.
 4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field

measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for interpretation to Designer according to Section 012613 "Request for Interpretation."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Designer promptly.
- B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish limits on use of Project site.
 - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 4. Inform installers of lines and levels to which they must comply.
 - 5. Check the location, level and plumb, of every major element as the Work progresses.
 - 6. Notify Designer 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 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 Designer and Owner.

3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Survey Accuracy: Horizontal and vertical locations shall be $\pm 0.25'$. Survey (NAD83-North Carolina State Plane Coordinates) shall tie to NC State's horizontal and vertical control monuments.
- C. 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 Designer . Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Designer before proceeding.
 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- D. 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.
- E. 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.
- F. Final Survey: Prepare a final survey showing significant features (real property and utilities) 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.
 2. Recording: At Final Acceptance, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."
 3. Utility Drawing Set (Hard Copy)
 - a. Cover Sheet - All projects require a cover sheet with the following information:
 - 1) NC State Project Name
 - 2) NC State Project Number
 - 3) NC State Building Name (s)
 - 4) NC State Building Number or Utility Zone Number (s)
 - 5) Project Phase (i.e. Schematic Design, Design Development, 100% Bid Documents, or Record Set)
 - 6) Sheet Name with discipline letter preceding sheet number (i.e. A100 for an Architectural Plan).
 - 7) Drawing Index
 - 8) Site Map
 - 9) For interior renovations, a hatched key plan indicating the extent of work
 - b. Drawing Sizes – sheet sizes shall not exceed 36" x 48" and shall not be less than 24" x 36" in size.
 - c. Include licensing seal and certification on 100% bid documents and record set documents.

4. Utility Drawing Set (Electronic Copy)
 - a. Format shall be .pdf.
 - b. Submission is required at each project phase.
 - c. File naming shall be as follows:
 - 1) Typical file naming shall be as follows -
bldg # _ncsu project number _date _phase.pdf or
utility zone # _ncsu project number _date _phase.pdf
 - 2) Example: 799Z_201300001_10-31-12_sd.pdf
 - 3) For projects with multiple buildings or utility zones, the lowest number shall be used in file name.
5. Electronic Source CADD Files (Record Set and first Construction Document Submittal)
 - a. Electronic files of all drawings shall include source drawings, font libraries, custom line styles/codes, plot style tables and other digital CADD related information.
 - b. The files shall be in AutoCAD .dwg format; the AutoCAD version shall be within the last 2 years of the current release.
 - c. Drawings shall be drawn at a scale of 1 to 1 in model space. Interior spaces shall be in Architectural inches. Exterior space shall be in US survey foot.
 - d. For exterior projects use NAD 83 North Carolina State plane coordinates.
 - e. All external references shall be bound as inserts or inserted directly as a block into the drawing. X-refs of any kind are not acceptable.
 - f. Remove licensing seals from drawing files.
 - g. Drawings shall be purged and audited.
 - h. Submission shall not include backup .bak files or .zip files.
 - i. Site, Civil, and Survey drawings shall use the NC State mapping drawing template, which includes NC State standard layers, linetypes and blocksymbols. The current version can be downloaded at [www.ncsu.edu/facilities/con_guidelines/NCSU CIV-SRV_TEMPLATE.dwg](http://www.ncsu.edu/facilities/con_guidelines/NCSU_CIV-SRV_TEMPLATE.dwg)
6. Utility Submission
 - a. Hard Copy - The Drawing Set shall be submitted on bond paper.
 - b. Electronic Files for the Record Drawing Set and Source CADD Files shall be accompanied by a transmittal with a listing of the included documents and the following information:
 - 1) NC State Project Number
 - 2) NC State Project Name
 - 3) NC State Building Number(s)
 - 4) NC State Building Name (s)
 - 5) NC State Project Manager's Name and Phone Number
 - 6) Submitting Professional's Name and Address
 - c. Electronic Files shall be submitted on a CD or DVD
 - 1) A .pdf file of the transmittal shall be included on each disk.

3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 3. Make vertical work plumb and make horizontal work level.
 - 4. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 5. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated. Where indicated to remain exposed, arrange overhead systems in an orderly manner.
 - 6. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Final Acceptance.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Do not use tools or equipment that produces harmful noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions
 - 3. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Designer.
 - 4. Allow for building movement, including thermal expansion and contraction.
 - 5. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.
- K. Protect adjacent property and adjoining work, including sealant bond surfaces, from spillage or blow-over of coatings, paints, sprayed fire-resistive material, and other

spray-applied products. Cover adjoining and nearby surfaces, including live plants and grass, if there is possibility of spray-applied products being deposited on surfaces.

3.6 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 3. 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. 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.
 - 3. 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.
 - 4. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 5. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill. Avoid cutting steel reinforcement.
 - a. Locate steel reinforcement using Ground Penetrating Radar or Ferroskan prior to cutting or drilling reinforced concrete and masonry. If existing steel reinforcement is in proposed cut or hole location, contact Designer before proceeding with the Work.
 - 6. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.
 - 7. 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.
 - 8. Proceed with patching after construction operations requiring cutting are complete.
- E. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
 - 3. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 - 4. 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.
 - 5. 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.
 - 6. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 - 7. Ceramic Tile: Provide ceramic tile and grout to match existing. Remove and replace tile damaged as a result of Work of this Contract. Comply with TCNA's "Handbook for Ceramic Tile Installation" for installation method to match existing. Lay tile in grid pattern to match existing. Make joints between existing and new tile same width so patches are not apparent in finished work.
 - 8. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- F. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction forces.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction forces.
- 3. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
- 4. Preinstallation Conferences: Include Owner's construction forces at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction forces if portions of the Work depend on Owner's construction.

3.8 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
- 3. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.

4. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
 5. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- 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.
3. Remove liquid spills promptly.
 4. 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: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted. Comply with Section 017419 "Construction Waste Management and Disposal."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Final Acceptance.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.
- 3.9 STARTING AND ADJUSTING
- A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 019113 "General Commissioning Requirements."
 - B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
 - C. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.
 - 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: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Section 014000 "Quality Requirements."

3.10 PROTECTION 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. 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 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Salvaging, Recycling, and Disposal of nonhazardous demolition and construction waste.
 - 2. Handling and disposing of hazardous demolition and construction waste.
- B. Related Sections include the following:
 - 1. Section 006000 "Project Forms" for the Designer Waste Information Form for the project and Non-Hazardous Waste Tracking Forms.

1.2 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 and waste materials (i.e. brick, concrete, asphalt, and aggregate).
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Special Waste: Solid wastes that require special handling and management.
- D. Hazardous Waste: Any solid waste that is ignitable, corrosive, reactive, or toxic; a listed hazardous material or containing a listed hazardous material per Title 40 Code of Federal Regulations Parts 260-270.
- E. Universal Waste: Hazardous wastes that have been provided specific exemptions (40 CFR 273) to encourage recycling. Universal wastes are limited to recalled or cancelled pesticides and intact batteries, lamps, and mercury containing devices. State regulations prohibit the crushing of fluorescent lamps.
- F. 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.
- G. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- H. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- I. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.3 ACTION SUBMITTALS

- A. Waste Management Plan: Submit plan within 30 days of date established for the Notice

to Proceed.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For waste management coordinator.

1.5 CLOSEOUT SUBMITTALS

- A. Hazardous Waste Disposal Certificates: Contractor shall provide NC State with a copy of all hazardous, universal, and special waste disposal certifications and/or manifest for all waste shipped.
- B. Construction & Demolition Waste and Recycling Tracking Forms: All reuse, recycling, and landfilled materials are to be tracked and compiled on NC State's "Construction & Demolition Waste & Recycling Tracking Form", which is included in Section 006000 "Project Forms".
- C. Construction & Demolition Salvaged Material Form: All salvaged materials are to be tracked and compiled on NC State's "Construction & Demolition Salvaged Material Form" which is included in Section 006000 "Project Forms".

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Waste Management Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
1. Review and discuss waste management plan including responsibilities of waste management coordinator.
 2. Review requirements for documenting quantities of each type of waste and its disposition.
 3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
 4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
 5. Review waste management requirements for each trade.

1.7 WASTE MANAGEMENT PLAN

- A. General: The plan shall include details on how the hazardous and non-hazardous generated waste will be managed in accordance with local, state, and federal regulations. Contractor must also provide all materials, personnel, and protective equipment necessary to remove and store wastes in accordance with the plan. The Contractor must coordinate salvage or reuse efforts identified on the Designer Waste Information Form with NC State and/or the non-profit entity.
- B. Waste Identification: Indicate anticipated types and quantities of demolition site-clearing and construction waste generated by the Work.
- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator.

1. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
 2. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
- D. 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.

1.8 PERFORMANCE GOALS & REQUIREMENTS

- A. All hazardous and non-hazardous generated waste shall be managed in accordance with local, state, and federal regulations.
- B. Seventy-five percent (75%) of a project's non-hazardous waste must be diverted from landfill disposal through reuse and recycling.
- C. One hundred percent (100%) of yard waste must be diverted from landfill disposal through reuse and recycling.
- D. The Designer must complete the Designer Waste Information Form (<http://go.ncsu.edu/wasteinfoform>) and identify regulated wastes, as well as materials, fixtures, and equipment that are to be salvaged for reuse or recycled. The location of the staging area as well as the responsible party for removal, delivery, and/or pick up must also be included.
 1. The completed Designer Waste Information Form has been included in Section 006000 "Project Forms".

1.9 MANAGEMENT OF HAZARDOUS, UNIVERSAL, AND SPECIAL WASTES

- A. Hazardous, universal, and special wastes must be managed separately from other C&D wastes.
- B. Disposal must be coordinated with NC State Environmental Health & Safety.
- C. Special wastes include:
 1. Paints, varnish, solvents, sealers, thinners, resins, roofing cement, adhesives, lubricants, and caulk, or drums and containers that once held these materials.
 2. Treated wood including lumber, posts, ties, decks, and utility poles (creosote, arsenic, chromium, pentachlorophenol).
 3. Asbestos, PCBs, mercury, or lead containing materials
 4. Used oil
 5. Lead acid batteries
 6. Medical wastes
- D. Waste disposal responsibility falls to one of two parties: the Contractor or NC State, as defined in the NC State Environmental Health and Safety's document: Management of Building Demolition Debris available at: <http://go.ncsu.edu/demodebris>

1. Containers used for waste storage must be United States Department of Transportation approved. The Contractor must supply bins, tanks or tank trucks. Containers must remain closed at all times except when material is being added. NC State will provide containers for items collected by NC State.
2. Hazardous waste containers must have labels that clearly identify waste streams. Different waste streams cannot be combined in a shared container. The Contractor must identify the initial accumulation date on the hazardous waste label when waste is first placed in the container.
3. Waste containers must be stored in a secured, covered, and well identified area of the construction site. Hazardous waste cannot be stored for more than 90 days. Any waste stored for more than six days must be inspected, and the inspection documented, weekly.
4. Spill response supplies must be on-site and adequate to contain 110% of any accumulated waste. Portable fire extinguishers must also be readily available. If a spill occurs, Contractor must contact NC State immediately and proceed with spill containment and clean up.
5. The Contractor must provide NC State with a copy of all hazardous, universal, and special waste disposal certifications and/or manifests for all waste shipped.

1.10 MANAGEMENT OF NON-HAZARDOUS WASTE

A. Priority 1 - Salvage of Construction and Demolition Waste for Reuse

1. Salvaged materials should first be evaluated for use in University construction projects. NC State Surplus Property Services should be considered if there are reusable materials that have resale value and are no longer needed by the University. Contact Waste Reduction and Recycling (recycle@ncsu.edu) for assistance with disposition. Examples of Salvageable material include:
 - a) Furniture and electronics
 - b) Cabinets and shelves that are not built-in
 - c) Sinks and water fountains
 - d) Paper towel dispensers
 - e) Newer light fixtures
 - f) Dry erase boards, chalkboards, and cork boards
 - g) Solid wood panel doors
 - h) Brick pavers
2. Contact vendors about take-back programs to recycle materials their company provides. These materials include, but are not limited to ceiling tiles, carpet tiles, and cubicle walls.
3. Coordinate with the Project Manager to utilize the NC State Construction Shop for the careful removal of salvageable items prior to contractor demolition. An estimate for the Construction Shop's work must be received during design and must be initiated prior to the project going out to bid.

B. Priority 2 - Recycling of Construction and Demolition Waste

1. If materials are not a salvageable for reuse, they must be source separated to the greatest extent possible and recycled.
2. Common source separated materials for recycling include:
 - a) Cardboard
 - b) Bottles and cans

- c) Scrap metal and wire
- d) Rigid plastics
- e) Untreated/unpainted dimensional lumber
- f) Gypsum board (unpainted)
- g) Concrete
- h) Asphalt (pavement and shingles)
- i) Aggregate
- j) Brick and CMU
- k) Carpet and Pad

3. 100% of the following materials must be recycled:

- a) Paper
- b) Cardboard
- c) Bottles and cans
- d) Scrap metal and wire
- e) Concrete
- f) Asphalt (pavement and shingles)
- g) Aggregate
- h) Brick and CMU
- i) Plastic sheet and film
- j) Polystyrene packaging
- k) Wood crates
- l) wood pallets
- m) plastic pails

C. Priority 3 - Disposal of Construction and Demolition Waste

- 1. If material/s cannot be salvaged for reuse or source separated and recycled, they must be sent to a C&D recycling and reclamation facility. Materials are not to be sent directly to a landfill or a facility that does not sort and recycle.
- 2. Regardless of salvage/recycle goal indicated in "General" paragraph above, salvage or recycle 100% of the following construction office waste materials:
 - a) Paper
 - b) Aluminum cans
 - c) glass containers

D. All solid waste management facilities must be permitted to operate by NCDEQ in accordance with 15A NCAC 13B .0201.

1.11 DUMPSTER SERVICES

- A. Contractor is responsible for providing the dumpster for the project.

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 everyone concerned within three days of submittal return.
 - 2. 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. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 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.
 - 2. Inspect containers and bins for contamination and remove contaminated materials if found.
 - 3. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 4. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 - 5. Store components off the ground and protect from the weather.
 - 6. Remove recyclable waste from Owner's property and transport to recycling

receiver or processor.

3.3 RECYCLING DEMOLITION WASTE

- A. Asphalt Paving: Break up and transport paving to asphalt-recycling facility.
- B. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
- C. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
 - 1. Clean and stack undamaged, whole masonry units on wood pallets.
- D. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
- E. 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.
- F. 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.
- G. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.
- H. Metal Suspension System: Separate metal members including trim, and other metals from acoustical panels and tile and sort with other metals.
- I. Carpet and Pad: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.
 - 1. Store clean, dry carpet and pad in a closed container or trailer provided by Carpet Reclamation Agency or carpet recycler.
- J. 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.
- K. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.
- L. Conduit: Reduce conduit to straight lengths and store by type and size.

3.4 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. Comply with requirements in Section 329300 "Plants" for use of clean sawdust as organic mulch.

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

1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

3.5 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.

PART 4 - END OF SECTION 017419

SECTION 017700 - CLOSEOUT

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Section 006000 "Project Forms" for Completion Checklists and Project Acceptance forms.
 - 2. Section 012900 "Payment Procedures" for Payment at Final Acceptance .
 - 3. Section 013100 "Project Management & Coordination" for information regarding the Project Website used for the Punch List(s).
 - 4. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.
 - 5. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
 - 6. Section 017846 "Maintenance Materials" for submitting maintenance materials requirements.
 - 7. Section 017900 "Demonstration & Training" for completing training and submitting documentation of completed training.

1.2 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.

1.3 ACTION SUBMITTALS

- A. Product Data: For cleaning agents used during Final Clean.
- B. Contractor's Pre-Final Punch List: Submitted no later than thirty (30) calendar days prior to Final Acceptance.
- C. Final Inspection Punch List: Submitted at Final Acceptance. All work must be complete within thirty (30) calendar days of the Final Inspection.

1.4 CLOSEOUT SUBMITTALS

- A. As listed in the checklists referenced in Paragraph 1.5 of this Section, and as itemized in the various Specification Sections of this Project Manual.
- B. Closeout Submittal Log: Contractor shall, at 50% complete, as determined by the project schedule, submit to Designer a log of schedule of all Closeout Submittals required by the Project Documents.

1.5 FINAL ACCEPTANCE PROCEDURES

- A. The checklists and timelines listed herein are organized in a manner to prepare the Project Team for SCO's Inspection for Beneficial Occupancy (if applicable) and SCO's Final Inspection for Final Acceptance. The checklists provided herein are required to be

completed in the timelines provided herein in their entirety, but the checklists do not replace the SCO Forms for Beneficial Occupancy and Final Acceptance, both of which are included in Section 006000 "Project Forms" and will be uploaded by the Designer to Interscope after the milestone is achieved.

- B. Request for Designers Pre-Final Inspection: No less than ten (10) working days prior to Designer's Pre-Final Inspection, Contractor shall submit to Designer, in an organized .zip folder, the items shown on the Request for Designers Pre-Final Inspection Checklist, as included in Section 006000 "Project Forms".
 - C. Request for Final Inspection: No less than ten (10) working days prior to the SCO Final Inspection, Contractor shall submit to Designer, in an organized .zip folder, the items shown on the Request for Final Inspection Checklist, as included in Section 006000 "Project Forms".
 - 1. If the project has a phase that requires Beneficial Occupancy, as noted in Article 23 of the Supplemental General Conditions, use the Request for Final Inspection Checklist to prepare for Beneficial Occupancy.
 - D. Final Inspection: To achieve Final Acceptance, all items on the Final Acceptance Checklist must be complete. Contractor shall submit to Designer, in an organized .zip folder, all items shown on the Final Acceptance Checklist. Once all items on the Final Acceptance Checklist are complete, the Project has achieved Final Acceptance.
 - E. Project Closeout: Prior to Final Payment, Contractor must submit all items on the Project Closeout Checklist as included in Section 006000 "Project Forms".
- 1.6 LIST OF INCOMPLETE ITEMS (CONTRACTORS COMPLETION / DESIGNER PUNCH LIST)
- A. Preparation: 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, proceeding from lowest floor to highest floor.
 - 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
 - 3. Include the following information at the top of each page:
 - a. NC State Project Name and location.
 - b. NC State Project Number, Code & Item, and State Construction Office Project Number.
 - c. Date.
 - d. Name of Designer.
 - e. Name of Contractor.
 - f. Page number.
 - B. Submit list of incomplete items in electronic tracking system format. Designer will utilize agreed upon electronic tracking system (Project Website). Access shall be provided by the contractor.
 - 1. Required Functions of Electronic Tracking System:

- a. Ability to download and sync tasks with Apple iPad over non-persistent wireless internet connection.
 - b. Drawing markup and viewing, for location identification of incomplete items.
 - c. Authorship tracking of each comment and subsequent action, including timestamps.
 - d. Sortable, filterable, itemized listing of incomplete items, by at a minimum unique issue number, date, location, issue author and responsible party.
 - e. Ability to append photos and markups on photos for the purpose of identifying incomplete items and demonstrating completeness of items.
 - f. Ability to incorporate Designer's provided list of pre-generated comments.
- C. Designer will direct all incomplete items to the attention of the Contractor, who shall identify responsible subcontractors.
- D. Contractor shall verify all items for completion prior to forwarding to Designer for action. To the maximum extent feasible, items shall be documented for closeout with clear photographs in the software, taken with context to identify the specific issue is resolved.

1.7 PROJECT RECORD DOCUMENTS

- A. Provide Project Record Documents as specified in Section 017839 "Project Record Documentation".

1.8 OPERATION AND MAINTENANCE MANUALS

- A. Assemble and provide complete set of operation and maintenance data as specified in Section 017823 "Operation & Maintenance Data".

1.9 SUBMITTAL OF PROJECT WARRANTIES

- A. Submit written warranties as specified in Section 017823 "Operation & Maintenance Data".

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by the 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: Provide 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 Designers Pre-Final Inspection:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are 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 hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Restore reflective surfaces to their original condition.
 - g. Remove debris and surface dust from limited access spaces, including plenums, shafts, and similar spaces.
 - h. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
 - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces. Remove labels that are not meant to be permanent.
 - k. Wipe surfaces of mechanical and electrical equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - l. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - m. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - n. Clean ducts, blowers, and coils if units were operated without filters during construction.
 - o. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in lighting fixtures to comply with requirements for new fixtures.
 - p. 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 before requesting inspection for

determination of Substantial Completion.

- B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
 - b. Do not paint over labels for fire resistive joints.
 3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.

END OF SECTION 017700

SECTION 017823 – OPERATION & MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout.

1.2 RELATED DOCUMENTS

- A. Section 006000 "Project Forms" for forms preparing for Final Acceptance.
- B. Section 013300 "Submittal Procedures" for requirements associated with the submission and approval of Submittals.
- C. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance manual(s) as required by the Project Documents.

1.4 OPERATION AND MAINTENANCE MANUALS

- A. Assemble a complete set of operation and maintenance data indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system. Include operation and maintenance data required in individual Specification Sections and as follows:

- 1. Operation Data:

- a. Emergency instructions and procedures.
- b. System, subsystem, and equipment descriptions, including operating standards.
- c. Operating procedures, including startup, shutdown, seasonal, and weekend operations.
- d. Description of controls and sequence of operations.
- e. Piping diagrams.
- f. Noise and vibration adjustments.
- g. Effective energy utilization.

- 2. Maintenance Data:

- a. Manufacturer's information, including list of spare parts.
- b. Name, address, and telephone number of Installer or supplier.
- c. Maintenance procedures.
- d. Maintenance and service schedules for preventive and routine maintenance.
- e. Maintenance record forms.
- f. Sources of spare parts and maintenance materials.
- g. Copies of maintenance service agreements.
- h. Copies of warranties and bonds.
- i. Cleaning.
- j. Control sequence.

- k. Fuels, lubricants, tool, and other related items.
 - l. Identification systems.
- B. Organize approved Operation and Maintenance manuals by Division in a bookmarked .pdf electronic file to submit to Owner.
- C. Print one set of hard copies of the Operation and Maintenance Manuals into suitable sets of manageable size. Bind and index data in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, with pocket inside the covers to receive folded oversized sheets. Identify each binder on front and spine with the printed title "OPERATION AND MAINTENANCE MANUAL," Project name, and subject matter of contents.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 017823

SECTION 017839 – PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for submitting record Drawings, record Specifications, and record Product Data.

1.2 RELATED DOCUMENTS

- A. Section 017700 "Closeout" for administrative and procedural requirements for contract closeout.

1.3 PROJECT RECORD DOCUMENTS

- A. General: Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for Designer's reference during normal working hours.
- B. Record Drawings: Maintain and submit one set of electronic Portable Document Format (.pdf) prints of Contract Drawings and Shop Drawings.
 - 1. 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 prepare the marked-up record prints.
 - a. Give particular attention to information on concealed elements that cannot be readily identified and recorded later, and the locations of those items that need to be located for servicing.
 - b. Accurately record information in a readily understandable drawing technique.
 - c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
 - d. Mark record prints completely and accurately.
 - e. Mark important additional information that was either shown schematically or omitted from original Drawings.
 - f. Note Change Order numbers, alternate numbers, and similar identification where applicable.
- C. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications. Clearly mark copy to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
 - a. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - b. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 - c. Note related Change Orders, Record Drawings, and Product Data, where applicable.

- D. Record Product Data: Submit one copy of each Product Data submittal. Mark one set to indicate the actual product installation where installation varies substantially from that indicated in Product Data.
- a. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - b. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 - c. Note related Change Orders, Record Drawings, where applicable.
- E. Miscellaneous Record Submittals: Assemble miscellaneous records required by other Specification Sections such as tests and inspections, and inspections by authorities having jurisdiction. Electronically bind in Portable Document Format (.pdf) and bookmark miscellaneous records and identify each, ready for continued use and reference.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017839

SECTION 017846 – MAINTENANCE MATERIALS AND ATTIC STOCK

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for maintenance materials (commonly referred to as “attic stock”).

1.2 RELATED DOCUMENTS

- A. Section 017700 “Closeout” for closeout requirements.
- B. Section 017823 “Operation and Maintenance Data” for operation and maintenance manual requirements.
- C. Section 017839 “Project Record Documents” for submitting record Drawings, record Specifications, and record Product Data.

1.3 CLOSEOUT SUBMITTALS

- A. Schedule of Maintenance Material and Attic Stock Items: For maintenance material submittal items listed below and as specified in other Sections. Contractor shall submit the following a minimum of 5 days prior to requesting an inspection for determining date of Final Acceptance for the Work or a designated portion thereof.
 - 1. Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Label with manufacturer's name and model number where applicable. Obtain Designer's signature for receipt of submittal.
- B. Maintenance Material and Attic Stock Transmittal: Prior to Final Acceptance, Contractor shall turn over all items on the Schedule of Maintenance Material Items to N.C. State. Contractor shall obtain N.C. State's recipients signature for each item received by each recipient.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Division 21 Fire Protection (if applicable)
 - 1. Required number of spare sprinkler heads in accordance with NFPA 13 and installed replacement head cabinets.
 - 2. Sprinkler wrenches provide two (2) per type of sprinkler installed.
 - 3. Concealed sprinkler cover plates equal to number installed.
- B. Division 23 Campus Automation (if applicable)
 - 1. Sensors provide one (1) of each type (hydronic, air supply and humidity)
 - 2. Zone thermostats provide two (2).
 - 3. Filters for the compressed air system provide two (2) sets.
- C. Division 26 Fire Alarm systems (if applicable)

1. Fuses provide two (2) of each size installed.
2. MPS with monitor modules provide a minimum of one (1) or 2% of total installed.
3. Audio-visual devices provide a minimum of one (1) or 4% of total installed.
4. Indoor strobe only devices, provide a minimum of one (1) or 4% of total installed.
5. Exterior indicating devices, provide a minimum of one (1) or 2% of total installed.
6. Spot Smoke Detectors provide a minimum of one (1) or 6% of total installed.
7. Spot heat/thermal detectors provide a minimum of one (1) or 6% of total installed.
8. Spot detector bases provide a minimum of one (1) or 2% of total installed.
9. Spot detector sounder bases provide a minimum of one (1) or 6% of total installed.
10. Relay modules provide a minimum of one (1) or 4% of total installed.
11. Monitor modules provide a minimum of one (1) or 4% of total installed.

PART 3 - EXECUTION (NOT USED)

END OF SECTION 017846

SECTION 017900 – DEMONSTRATION & TRAINING

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 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.

1.3 INFORMATIONAL SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit two (2) copies within seven (7) working days of the end of each training module.
 - 1. Identification: On each copy, provide an applied label with the following information:
 - a. Name of Project.
 - b. Name and address of videographer.
 - c. Name of Designer.
 - d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Date of video recording.
 - 2. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.
 - 3. At completion of training, submit complete training manual(s) for Owner's use prepared in same paper and PDF file format required for operation and maintenance manuals specified in Section 017823 "Operation and Maintenance Data."

B. Attendance Record: For each training module, submit list of participants and length of instruction time.

C. Evaluations: For each participant and for each training module, submit results and documentation of performance based test.

1.5 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

C. Videographer Qualifications: A competent videographer who is experienced photographing demonstration and training events similar to those required. If Contractor is to have their personnel perform the videography, Contractor must send a sample of audio and video quality to Owner and Designer for approval prior to the training being scheduled. Sample audio and video must be representative of the camera and microphone that will be used during the training.

D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:

1. Inspect and discuss locations and other facilities required for instruction.
2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
3. Review required content of instruction.
4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.6 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Designer.

1.7 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training

modules for each system and for equipment not part of a system, as required by individual Specification Sections.

- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Systems and equipment operation manuals.
 - c. Systems and equipment maintenance manuals.
 - d. Product maintenance manuals.
 - e. Project Record Documents.
 - f. Identification systems.
 - g. Warranties and bonds.
 - h. Maintenance service agreements and similar continuing commitments.
 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.

- k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
- 5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
- 6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
- 7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning.
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
- 8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

1.8 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

1.9 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Designer will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.

2. Owner will furnish an instructor to describe Owner's operational philosophy.
 3. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
1. Schedule training with Owner with at least seven days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.
- F. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

1.10 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum recording quality of UHD 4k at 30 fps with vibration reduction technology. Use an external directional microphone (Rode VideoMic GO, or equivalent) to capture audio.
1. Submit video recordings on thumb drive.
 2. File Hierarchy: Organize folder structure and file locations according to Project Manual table of contents. Provide complete screen-based menu.
 3. File Names: Utilize file names based on name of equipment generally described in video segment, as identified in Project specifications.
 4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the equipment demonstration and training recording that describes the following for each Contractor involved on the Project, arranged according to Project Manual table of contents:
 - a. Name of Contractor/Installer.
 - b. Business address.
 - c. Business phone number.
 - d. Point of contact.
 - e. Email address.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.

1. Film training session(s) in segments not to exceed 15 minutes.
 - a. Produce segments to present a single significant piece of equipment per segment.
 - b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
 - c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.
- D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
 1. Furnish additional portable lighting as required.
- E. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.
- F. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.
- G. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017900

SECTION 019113 - GENERAL COMMISSIONING 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.
- B. OPR and BoD documentation are included by reference for information only.

1.2 SUMMARY

- A. Section includes general requirements that apply to implementation of commissioning without regard to specific systems, assemblies, or components.
- B. Commissioning is systematic processes to provide documented confirmation that building systems perform according to the criteria set forth in the design intent and satisfy the owner's operational needs. This is achieved by beginning in the design phase and documenting design intent and continuing through construction, acceptance and the warranty period with actual verification of performance. The commissioning process shall encompass and coordinate the traditionally separate functions of system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training.
- C. Commissioning during the construction phase is intended to achieve the following specific objectives according to the Contract Documents:
 - 1. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
 - 2. Verify and document proper performance of equipment and systems.
 - 3. Verify that O&M documentation left on site is complete.
 - 4. Verify that the Owner's operating personnel are adequately trained.
- D. The commissioning process does not take away from or reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product.
- E. Abbreviations._ The following are common abbreviations used in the *Specifications* and in the *Commissioning Plan*. Definitions are found in Section 1.3.

A/E-	Architect and design engineers	GC-	General contractor (prime)
CxA-	Commissioning authority	MC-	Mechanical contractor
CC	Controls contractor	OR-	Owner's Representative
		PC-	Prefunctional checklist
Cx-	Commissioning	PM-	Project manager (of the Owner)
Cx Plan-	Commissioning Plan document	Subs-	Subcontractors to General
EC-	Electrical contractor	TAB-	Test and balance contractor
FT-	Functional performance test		

F. Related Sections:

1. *Division 22 Section "Commissioning of Plumbing" for commissioning process activities for plumbing systems, assemblies, equipment, and components.*
2. *Division 23 Section "Commissioning of HVAC" for commissioning process activities for HVAC&R systems, assemblies, equipment, and components.*
3. *Division 26 Section "Commissioning of Electrical Systems" for commissioning process activities for integrated automation systems, assemblies, equipment, and components.*
4. *DIVISION 28 - ELECTRONIC SAFETY AND SECURITY: 284621.11 ADDRESSABLE FIRE-ALARM SYSTEMS*

1.3 DEFINITIONS

- A. Acceptance Phase. Phase of construction after startup and initial checkout when functional performance tests, O&M documentation review and training occurs.
- B. Approval. Acceptance that a piece of equipment or system has been properly installed and is functioning in the tested modes according to the Contract Documents.
- C. Architect/Engineer (A/E): The prime consultant (architect) and sub-consultants who comprise the design team, generally the HVAC mechanical designer/engineer and the electrical designer/engineer.
- D. BoD: Basis of Design. A document that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.
- E. CxA: Commissioning Authority. An independent agent, not otherwise associated with the A/E team members or the Contractor, hired by the Owner. The CxA directs and coordinates the day-to-day commissioning activities. The CxA does not take an oversight role like the OR. The CxA shall report directly to the OR.
- F. Cx Plan: Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process
- G. Datalogging: Monitoring flows, currents, status, pressures, etc. of equipment using stand-alone dataloggers separate from the control system.
- H. Deferred Functional Tests : FTs that are performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design or other site conditions that disallow the test from being performed.
- I. Deficiency : A condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents (that is, does not perform properly or is not complying with the design intent)

- J. Design Intent: A dynamic document that provides the explanation of the ideas, concepts and criteria that are considered to be very important to the owner. It is initially the outcome of the programming and conceptual design phases.
- K. Design Narrative or Design Documentation: Sections of either the Design Intent or Basis of Design.
- L. Factory Testing: Testing of equipment on-site or at the factory by factory personnel with an Owner's representative present.
- M. Functional Performance Test (FT): Test of the dynamic function and operation of equipment and systems using manual (direct observation) or monitoring methods. Functional testing is the dynamic testing of systems (rather than just components) under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint). Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system's sequences of operation and components are verified to be responding as the sequences state. Traditional air or water test and balancing (TAB) is not functional testing, in the commissioning sense of the word. TAB's primary work is setting up the system flows and pressures as specified, while functional testing is verifying that which has already been set up. The commissioning authority develops the functional test procedures in a sequential written form, coordinates, oversees and documents the actual testing, which is usually performed by the installing contractor or vendor. FTs are performed after prefunctional checklists and startup are complete.
- N. General Contractor (GC): The prime contractor for this project. Generally refers to all the GC's subcontractors as well. Also referred to as the Contractor, in some contexts.
- O. Indirect Indicators: Indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100% closed
- P. Manual Test: Using hand-held instruments, immediate control system readouts or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the "observation").
- Q. Monitoring: The recording of parameters (flow, current, status, pressure, etc.) of equipment operation using dataloggers or the trending capabilities of control systems.
- R. Non-Compliance: See Deficiency.
- S. Non-Conformance: See Deficiency.
- T. Over-written Value: Writing over a sensor value in the control system to see the response of a system (e.g., changing the outside air temperature value from 50F to 75F to verify economizer operation). See also "Simulated Signal."
- U. OPR: Owner's Project Requirements. A document that details the functional requirements of a project and the expectations of how it will be used and operated. These include Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.
- V. Prefunctional Checklist (PC): A list of items to inspect and elementary component tests to conduct to verify proper installation of equipment, provided by the CxA to the Sub.

Prefunctional checklists are primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g., belt tension, oil levels OK, labels affixed, gages in place, sensors calibrated, etc.). However, some prefunctional checklist items entail simple testing of the function of a component, a piece of equipment or system (such as measuring the voltage imbalance on a three phase pump motor of a chiller system). The word prefunctional refers to before functional testing. Prefunctional checklists augment and are combined with the manufacturer's start-up checklist. Even without a commissioning process, contractors typically perform some, if not many, of the prefunctional checklist items a commissioning authority will recommend. However, few contractors document in writing the execution of these checklist items. Therefore, for most equipment, the contractors execute the checklists on their own. The commissioning authority only requires that the procedures be documented in writing, and does not witness much of the prefunctional checklisting, except for larger or more critical pieces of equipment.

- W. Sampling: Functionally testing only a fraction of the total number of identical or near identical pieces of equipment.
- X. Seasonal Performance Tests: FT that are deferred until the system(s) will experience conditions closer to their design conditions.
- Y. Simulated Condition: Condition that is created for the purpose of testing the response of a system (e.g., applying a hair blower to a space sensor to see the response in a VAV box).
- Z. Simulated Signal: Disconnecting a sensor and using a signal generator to send an amperage, resistance or pressure to the transducer and DDC system to simulate a sensor value.
- AA. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.
- BB. Startup: The initial starting or activating of dynamic equipment, including executing prefunctional checklists.
- CC. Subs: The subcontractors to the GC who provide and install building components and systems.
- DD. Test Procedures: The step-by-step process which must be executed to fulfill the test requirements. The test procedures are developed by the CxA.
- EE. Test Requirements: Requirements specifying what modes and functions, etc. shall be tested. The test requirements are not the detailed test procedures. The test requirements are specified in the Contract Documents
- FF. Trending: Monitoring using the building control system.
- GG. Vendor: Supplier of equipment.
- HH. Warranty Period: Warranty period for entire project, including equipment components. Warranty begins at Substantial Completion and extends for at least one year, unless specifically noted otherwise in the Contract Documents and accepted submittals.

1.4 COORDINATION

- A. Commissioning Team: The members of the commissioning team consist of the Commissioning authority (CxA), the Owner's Representative (OR), the General Contractor (GC or Contractor),

the architect and design engineers (particularly the mechanical engineer), the Mechanical Contractor (MC), the Electrical Contractor (EC), the TAB representative, the Controls Contractor (CC), any other installing subcontractors or suppliers of equipment. If known, the Owner's building or plant operator/engineer is also a member of the commissioning team.

- B. Management. The CxA is hired by the Owner directly. The CxA directs and coordinates the commissioning activities and the reports to the OR. All members work together to fulfill their contracted responsibilities and meet the objectives of the Contract Documents.
- C. Scheduling. The CxA will work with the OR and GC according to established protocols to schedule the commissioning activities. The CxA will provide sufficient notice to the OR and GC for scheduling commissioning activities. The GC will integrate all commissioning activities into the master schedule. All parties will address scheduling problems and make necessary notifications in a timely manner in order to expedite the commissioning process.
- D. The CxA will provide the initial schedule of primary commissioning events at the commissioning scoping meeting. The *Commissioning Plan—Construction Phase* provides a format for this schedule. As construction progresses more detailed schedules are developed by the CxA. The Commissioning Plan also provides a format for detailed schedules.

1.5 COMMISSIONING PROCESS

- A. Commissioning Plan. The commissioning plan provides guidance in the execution of the commissioning process. Just after the initial commissioning scoping meeting the CxA will update the plan which is then considered the “final” plan, though it will continue to evolve and expand as the project progresses. The *Specifications* will take precedence over the *Commissioning Plan*.
- B. Commissioning Process. The following narrative provides a brief overview of the typical commissioning tasks during construction and the general order in which they occur.
 - 1. Commissioning during construction begins with a scoping meeting conducted by the CxA where the commissioning process is reviewed with the commissioning team members.
 - 2. Additional meetings will be required throughout construction, scheduled by the CxA with necessary parties attending, to plan, scope, coordinate, schedule future activities and resolve problems.
 - 3. Equipment documentation is submitted to the CxA with initial submittals, including detailed start-up procedures, and OMs. Equipment with package controls will have factory narrative sequence of operation provided as well as equipment line drawings depicting sensor and device location.
 - 4. The CxA works with the Subs in developing startup plans and startup documentation formats, including providing the Subs with prefunctional checklists to be completed, during the startup process by the installing contractors.
 - 5. In general, the checkout and performance verification proceeds from simple to complex; from component level to equipment to systems and intersystem levels with prefunctional checklists being completed before functional testing.
 - 6. The Subs, under their own direction, execute and document the prefunctional checklists and perform startup and initial checkout in commissioning software. General contractor responsible for tracking document progression compared to project completion. The CxA documents that the checklists and startup were completed according to the approved plans. This may include the CxA witnessing start-up of selected equipment. 48hr notice

of intent to perform startup. Factory start up technicians shall be capable of mechanical validation and application of package controls to meet project requirements.

7. The CxA develops specific equipment and system functional performance test procedures. The Subs review the procedures.
8. The procedures are executed by the Subs, under the direction of, and documented by the CxA.
9. Items of non-compliance in material, installation or setup are corrected at the Sub's expense and the system retested.
10. The CxA reviews the O&M documentation for completeness.
11. Commissioning is completed before Substantial Completion.
12. The CxA reviews agendas and assist with coordinating the training provided by the Subs and verifies that it was completed.
13. Deferred testing is conducted, as specified or required.

1.6 COMMISSIONING TEAM

- A. Members Appointed by Contractor(s): Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated action. The commissioning team shall consist of, but not be limited to, the Owner's Representative (OR) and representatives of the Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.
- B. Members Appointed by Owner:
 1. CxA: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner will engage the CxA under a separate contract.
 2. Representatives of the facility user and operation and maintenance personnel.
 3. The Owners Representative.
 4. Architect and engineering design professionals.

1.7 OWNER'S RESPONSIBILITIES

- A. Work with the CxA and Contractor to develop the OPR documentation for information and use.
- B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.
- C. Provide the BoD documentation, prepared by Architect and approved by Owner, to the CxA and Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.
- D. Follow the Commissioning Plan.
- E. Attend commissioning scoping meetings and additional meetings as necessary.

1.8 OWNERS REPRESENTATIVE'S RESPONSIBILITIES

- A. The Owner's Representative OR shall represent the Owner during the commissioning process as follows:
1. Manage the contract of the A/E, CxA, OR and Contractor.
 2. Arrange for facility operating and maintenance personnel to attend various field commissioning activities and field training sessions according to the *Commissioning Plan – Construction Phase*.
 3. Provide final approval for the completion of the commissioning work.
 4. Ensure that any seasonal or deferred testing and any deficiency issues are addressed.
 5. Follow the Commissioning Plan.
 6. Attend commissioning scoping meetings and additional meetings as necessary.

1.9 ARCHITECT/ENGINEERS (AE) RESPONSIBILITIES

- A. The AE shall participate in and perform commissioning process activities including, but not limited to, the following:
1. Attend the commissioning scoping meeting and selected commissioning team meetings.
 2. Perform normal submittal review, construction observation, as-built drawing preparation, O&M manual preparation, etc., as contracted.
 3. Provide any design narrative and sequence documentation requested by the CxA. The designers shall assist (along with the contractors) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
 4. Coordinate resolution of system deficiencies identified during commissioning, according to the contract documents.
 5. Prepare and submit final as-built design intent documentation for inclusion in the O&M manuals. Review and approve the O&M manuals.
 6. Coordinate resolution of design non-conformance and design deficiencies identified during warranty-period commissioning.
 7. Participate in the resolution of non-compliance, non-conformance and design deficiencies identified during commissioning during warranty-period commissioning.
 8. Furnish a copy of all construction documents, addenda, requests for information, change orders and approved submittals and shop drawings related to commissioned equipment to the CxA.

1.10 CONSTRUCTION MANAGER'S (CM) RESPONSIBILITIES

- A. Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:
1. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
 2. Cooperate with the CxA for resolution of issues recorded in the Issues Log.
 3. Attend commissioning team meetings held as required.
 4. Integrate and coordinate commissioning process activities with construction schedule.
 5. Review commissioning progress and deficiency reports.
 6. Review and accept construction checklists provided by the CxA.

7. Complete paper or electronic construction checklists as work is completed and provide to the CxA on a weekly basis.
8. Review and accept commissioning process test procedures provided by the Commissioning Authority.
9. Complete commissioning process test procedures.
10. Include the cost of commissioning in the total contract price.
11. Coordinate the training of Owner personnel and provide the times and dates of training to the CxA.
12. Execute seasonal or deferred functional performance testing witnessed by the CxA to facilitate the Cx process.
13. Provide a list of final settings, setpoints, ranges, schedules, and / or trend logs required by the CxA.
14. Follow the Commissioning Plan.
15. Attend commissioning scoping meetings and additional meetings as necessary.
16. From the red-line drawings, edit and update one-line diagrams developed as part of the design narrative documentation and those provided by the vendor as shop drawings for the chilled and hot water, condenser water, domestic water, supply, return and exhaust air systems and power system.

1.11 SUB CONTRACTOR'S RESPONSIBILITIES

- A. Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:
1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner to keep warranties in force.
 2. Assist in equipment testing per agreements with Prime.
 3. Include all special tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment according to these Contract Documents in the base bid price to the Contractor, except for stand-alone data logging equipment that may be used by the CxA.
 4. Provide information requested by CxA regarding equipment sequence of operation and testing procedures.
 5. Review test procedures for equipment installed by factory representatives.
 6. Follow the Commissioning Plan.
 7. Attend commissioning scoping meetings and additional meetings as necessary.

1.12 EQUIPMENT SUPPLIERS RESPONSIBILITIES

- A. The equipment suppliers shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:
1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner to keep warranties in force.
 2. Assist in equipment testing per agreements with Subs.
 3. Include all special tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment according to these Contract Documents in the base bid price to the Contractor, except for stand-alone datalogging equipment that may be used by the CxA.

4. Through the contractors they supply products to, analyze specified products and verify that the designer has specified the newest most updated equipment reasonable for this project's scope and budget.
5. Provide information requested by CxA regarding equipment sequence of operation and testing procedures.
6. Review test procedures for equipment installed by factory representatives.
7. Follow the Commissioning Plan.
8. Attend commissioning scoping meetings and additional meetings as necessary.

1.13 CxA'S RESPONSIBILITIES

- A. The CxA is not responsible for design concept, design criteria, compliance with codes, design or general construction scheduling, cost estimating, or construction management. The CxA may assist with problem-solving non-conformance or deficiencies, but ultimately that responsibility resides with the general contractor and the A/E. The primary role of the CxA is to develop and coordinate the execution of a testing plan, observe and document performance—that systems are functioning in accordance with the documented design intent and in accordance with the Contract Documents. The Contractors will provide all tools or the use of tools to start, check-out and functionally test equipment and systems, except for specified testing with portable data-loggers, which shall be supplied and installed by the CxA.
1. Coordinates and directs the commissioning activities using consistent protocols and forms, centralized documentation, clear and regular communications and consultations with all necessary parties, frequently updated timelines and schedules and technical expertise.
 2. Coordinate the commissioning work and, with the GC and OR, ensure that commissioning activities are being scheduled into the master schedule.
 3. Revise, as necessary, the *Commissioning Plan—Construction Phase*.
 4. Plan and conduct a commissioning scoping meeting and other commissioning meetings.
 5. Request and review additional information required to perform commissioning tasks, including O&M materials, contractor start-up and checkout procedures.
 6. Before startup, gather and review the current control sequences and interlocks and work with contractors and design engineers until sufficient clarity has been obtained, in writing, to be able to write detailed testing procedures.
 7. Review and comment on normal Contractor submittals applicable to systems being commissioned for compliance with commissioning needs, concurrent with the A/E reviews.
 8. Write and distribute prefunctional tests and checklists.
 9. Develop an enhanced start-up and initial systems checkout plan with Subs.
 10. Perform site visits, as necessary, to observe component and system installations. Attends selected planning and job-site meetings to obtain information on construction progress. Review construction meeting minutes for revisions/substitutions relating to the commissioning process. Assist in resolving any discrepancies.
 11. Witness all or part of the HVAC piping test and flushing procedure, sufficient to be confident that proper procedures were followed. Document this testing and include the documentation in O&M manuals. Notify owner's representative of any deficiencies in results or procedures.
 12. Witness all or part of any ductwork testing and cleaning procedures, sufficient to be confident that proper procedures were followed. Document this testing and include the documentation in O&M manuals. Notify owner's representative of any deficiencies in results or procedures.
 13. Approve prefunctional tests and checklist completion by reviewing prefunctional checklist reports and by selected site observation and spot checking.

14. Approve systems startup by reviewing start-up reports and by selected site observation.
15. Review TAB execution plan.
16. Oversee sufficient functional testing of the control system and approve it to be used for TAB, before TAB is executed.
17. Approve air and water systems balancing by spot testing, by reviewing completed reports and by selected site observation.
18. With necessary assistance and review from installing contractors, write the functional performance test procedures for equipment and systems. This may include energy management control system trending, stand-alone datalogger monitoring or manual functional testing. Submit to OR for review, and for approval if required.
19. Analyze any functional performance trend logs and monitoring data to verify performance.
20. Coordinate, witness and approve manual functional performance tests performed by installing contractors. Coordinate retesting as necessary until satisfactory performance is achieved.
21. Maintain a master deficiency and resolution log and a separate testing record. Provide the OR with written progress reports and test results with recommended actions.
22. Review equipment warranties to ensure that the Owner's responsibilities are clearly defined.
23. Oversee and approve the training of the Owner's operating personnel.
24. Compile and maintain a commissioning record and building systems book(s).
25. Review and approve the preparation of the O&M manuals.
26. Provide a final commissioning report.
27. Coordinate and supervise required seasonal or deferred testing and deficiency corrections.
28. Return to the site at 10 months into the 12 month warranty period and review with facility staff the current building operation and the condition of outstanding issues related to the original and seasonal commissioning. Also interview facility staff and identify problems or concerns they have operating the building as originally intended. Make suggestions for improvements and for recording these changes in the O&M manuals. Identify areas that may come under warranty or under the original construction contract. Assist facility staff in developing reports, documents and requests for services to remedy outstanding problems.

1.14 SYSTEMS TO BE COMMISSIONED

- A. The following HVAC systems will be commissioned in this project.

1. *Air Handling Unit*
2. *Air Cooled Chiller*
3. *Boilers*
4. *Building Automation System*
5. *Ductwork*
6. *Exhaust Fan*
7. *Utility Metering*
8. *Piping and Specialties*
9. *Pumps*
10. *Testing, Adjusting and Balancing*
11. *Unit Heaters*
12. *Variable Frequency Drives*
13. *Variable Volume Terminal Units*

14. *Water Treatment/Makeup Water*

B. The following Plumbing systems will be commissioned in this project.

1. *Domestic Hot Water System*
2. *Domestic Water Heater*
3. *Hot Water Circulating Pump*
4. *Sump Pumps*

C. The following Electrical systems will be commissioned in this project.

1. *Emergency Power Systems*
2. *Electrical Distribution System*
3. *Lighting Controls*
4. *Metering*
5. *Fire Alarm*

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. All standard testing equipment required to perform startup and initial checkout and required functional performance testing shall be provided by the Division contractor for the equipment being tested. For example, the mechanical contractor of Division 23 shall ultimately be responsible for all standard testing equipment for the HVAC system and controls system in Division 23, except for equipment specific to and used by TAB in their commissioning responsibilities. Two-way radios shall be provided by the Division Contractor.
- B. Special equipment, tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment, according to these Contract Documents shall be included in the base bid price to the Contractor and left on site, except for stand-alone datalogging equipment that may be used by the CxA.
- C. Datalogging equipment and software required to test equipment will be provided by the CxA, but shall not become the property of the Owner.
- D. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the *Specifications*. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5°F and a resolution of + or - 0.1°F. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available.

- E. Refer to Section 019113, Part 3.6 E for details regarding equipment that may be required to simulate required test conditions.

PART 3 - EXECUTION

3.1 MEETINGS

- A. Scoping Meeting. Within 90 days of commencement of construction, the CxA will schedule, plan and conduct a commissioning scoping meeting with the entire commissioning team in attendance. Meeting minutes will be distributed to all parties by the CxA. Information gathered from this meeting will allow the CxA to revise the *Commissioning Plan* to its "final" version, which will also be distributed to all parties.
- B. Miscellaneous Meetings. Other meetings will be planned and conducted by the CxA as construction progresses. These meetings will cover coordination, deficiency resolution and planning issues with particular Subs. The CxA will plan these meetings and will minimize unnecessary time being spent by Subs. These meetings may be as required. During the final 3 months of construction they may be held as frequently as one per week. Meetings attendance is required during warranty period to verify corrective action to outstanding deviancies, perform seasonal testing, and conduct ten month warranty walkthrough.

3.2 REPORTING

- A. The CxA will provide regular reports to the OR, with increasing frequency as construction and commissioning progresses. Standard forms are provided and referenced in the *Commissioning Plan*.
- B. The CxA will regularly communicate with all members of the commissioning team, keeping them apprised of commissioning progress and scheduling changes through memos, progress reports, etc.
- C. Testing or review approvals and non-conformance and deficiency reports are made regularly with the review and testing as described in later sections.
- D. A final summary report (about four to six pages, not including backup documentation) by the CxA will be provided to the OR, focusing on evaluating commissioning process issues and identifying areas where the process could be improved. All acquired documentation, logs, minutes, reports, deficiency lists, communications, findings, unresolved issues, etc., will be compiled in appendices and provided with the summary report. Prefunctional checklists, functional tests and monitoring reports will not be part of the final report, but will be stored in the Commissioning Record in the O&M manuals.

3.3 SUBMITTALS

- A. The CxA will provide appropriate contractors with a specific request for the type of submittal documentation the CxA requires to facilitate the commissioning work. These requests will be integrated into the normal submittal process and protocol of the construction team. At minimum, the request will include the manufacturer and model number, the manufacturer's printed

installation and detailed start-up procedures, full sequences of operation, O&M data, performance data, any performance test procedures, control drawings and details of owner contracted tests. In addition, the installation and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning authority. All documentation requested by the CxA will be included by the Subs in their O&M manual contributions.

1. Requested Submittals:
 - a. Refer to Section 019113-10 Part 1.15 Systems to be Commissioned

- B. The Commissioning authority will review and provide comment on submittals related to the commissioned equipment for conformance to the Contract Documents as it relates to the commissioning process, to the functional performance of the equipment and adequacy for developing test procedures. This review is intended primarily to aid in the development of functional testing procedures and only secondarily to verify compliance with equipment specifications. The Commissioning authority will notify the OR, Owner Representative, or A/E as requested, of items missing or areas that are not in conformance with Contract Documents and which require resubmission.
- C. The CxA may request additional design narrative from the A/E and Controls Contractor, depending on the completeness of the design intent documentation and sequences provided with the Specifications.
- D. These submittals to the CxA do not constitute compliance for O&M manual documentation. The O&M manuals are the responsibility of the Contractor, though the CxA will review and approve them.
- E. Contractor's responsibility for deviations in submittals from requirements of the Contract Documents is not relieved by the Commissioning Authority's review.

3.4 START-UP, PREFUNCTIONAL CHECKLISTS AND INITIAL CHECKOUT

- A. The following procedures apply to all equipment to be commissioned, according to Section 1.15, Systems to be commissioned. Some systems that are not comprised so much of actual dynamic machinery, e.g., electrical system power quality, may have very simplified PFCs and startup.
- B. General. Prefunctional checklists are important to ensure that the equipment and systems are hooked up and operational. It ensures that functional performance testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full prefunctional checkout. No sampling strategies are used. The prefunctional testing for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.
- C. Start-up and Initial Checkout Plan. The CxA shall assist the commissioning team members responsible for startup of any equipment in developing detailed start-up plans for all equipment. The primary role of the CxA in this process is to ensure that there is written documentation that each of the manufacturer-recommended procedures have been completed. Parties responsible for prefunctional checklists and startup are identified in the commissioning scoping meeting and in the checklist forms. Parties responsible for executing prefunctional performance tests are identified in the testing requirements in Sections 220800, 230800, and 260800.

1. The CxA develops prefunctional checklists and procedures. These checklists indicate required procedures to be executed as part of startup and initial checkout of the systems and the party responsible for their execution.
2. These checklists and tests are provided by the CxA to the Contractor. The Contractor determines which trade is responsible for executing and documenting each of the line item tasks and notes that trade on the form. Each form will have more than one trade responsible for its execution.
3. The subcontractor responsible for the purchase of the equipment develops the full start-up plan by combining (or adding to) the CxA's checklists with the manufacturer's detailed start-up and checkout procedures from the O&M manual and the normally used field checkout sheets. The plan will include checklists and procedures with specific boxes or lines for recording and documenting the checking and inspections of each procedure and a summary statement with a signature block at the end of the plan. The full start-up plan could consist of something as simple as:
 - a. The CxA's prefunctional checklists.
 - b. The manufacturer's standard written start-up procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end.
 - c. The manufacturer's or contractors normally used field checkout sheets.
 - d. Any forms required for warranty submission
4. The subcontractor submits the full startup plan to the CxA for review and approval.
5. The CxA reviews and approves the procedures and the format for documenting them, noting any procedures that need to be added.
6. The full start-up procedures and the approval form may be provided to the OR for review and approval, depending on management protocol.

D. Sensor and Actuator Calibration.

1. All field-installed temperature, relative humidity, CO, CO₂ and pressure sensors and gages, and all actuators (dampers and valves) on all equipment shall be calibrated using the methods described below. Alternate methods may be used, if approved by the Owner before-hand. All test instruments shall have had a certified calibration within the last 12 months. Sensors installed *in* the unit at the factory with calibration certification provided need not be field calibrated.
2. All procedures used shall be fully documented on the prefunctional checklists or other suitable forms, clearly referencing the procedures followed and written documentation of initial, intermediate and final results.
3. Sensor Calibration Methods.
 - a. All Sensors. Verify that all sensor locations are appropriate and away from causes of erratic operation. Verify that sensors with shielded cable are grounded only at one end. For sensor pairs that are used to determine a temperature or pressure difference, make sure they are reading within 1°F of each other for temperature and within a tolerance equal to 5% of the reading, of each other, for pressure. Tolerances for critical applications may be tighter.
 - b. Sensors without Transmitters--Standard Application. Make a reading with a calibrated test instrument within 6 inches of the site sensor. Verify that the sensor reading (via the permanent thermostat, gage or building automation system (BAS)) is within the tolerances in the table below of the instrument-measured value. If not, install offset in BAS, calibrate or replace sensor.

- c. Critical Applications. For critical applications (process, manufacturing, etc.) more rigorous calibration techniques may be required for selected sensors. Describe any such methods used on an attached sheet.

Standard Applications Tolerances Unless stated elsewhere

<u>Sensor</u>	<u>Required Tolerance (+/-)</u>	<u>Sensor</u>	<u>Required Tolerance (+/-)</u>
Cooling coil, chilled and condenser water temps	1.0F	Flow rates, water	10% of design
AHU wet bulb or dew point	2.0F	Relative humidity	10% of design
Hot water coil and boiler water temp	1.0F	Combustion flue temps	5.0F
Outside air, space air, duct air temps	0.4F	Oxygen or CO ₂ monitor	5.0 % pts
Pressures, air, water	5%	CO monitor	2.0 % pts
Flow rates, air	10% of design	Averaging Sensors	3.0F

4. Valve and Damper Stroke Setup and Check.

- EMS Readout. For all valve and damper actuator positions checked, verify the actual position against the BAS readout.
- Set pumps or fans to normal operating mode. Command valve or damper closed, visually verify that valve or damper is closed and adjust output zero signal as required. Command valve or damper open, verify position is full open and adjust output signal as required. Command valve or damper to a few intermediate positions. If actual valve or damper position doesn't reasonably correspond, replace actuator.

- Closure for heating coil valves (NO): Set heating setpoint 20°F above room temperature. Observe valve open. Remove control air or power from the valve and verify that the valve stem and actuator position do not change. Restore to normal. Set heating setpoint to 20°F below room temperature. Observe the valve close. Verify valve stem and actuator position does not change. Restore to normal.
- Closure for cooling coil valves (NC): Set cooling setpoint 20°F above room temperature. Observe the valve close. Remove power from the valve and verify that the valve stem and actuator position do not change. Restore to normal. Set cooling setpoint to 20°F below room temperature. Observe valve open.

E. Execution of Prefunctional Checklists and Startup.

- Four weeks prior to startup, the Subs and vendors schedule startup and checkout with the OR, GC and CxA. The performance of the prefunctional checklists, startup and checkout are directed and executed by the Sub or vendor. When checking off prefunctional checklists, signatures may be required of other Subs for verification of completion of their work.
- The CxA shall observe, at minimum, the procedures for each piece of primary equipment, unless there are multiple units, (in which case a sampling strategy may be used as approved by the OR). In no case will the number of units witnessed be less than four on any one building, nor less than 20% of the total number of identical or very similar units.

3. For lower-level components of equipment, (e.g., VAV boxes, sensors, controllers), the CxA shall observe a sampling of the prefunctional and start-up procedures. The sampling procedures are identified in the commissioning plan.
4. The Subs and vendors shall execute startup and provide the CxA with a signed and dated copy of the completed start-up and prefunctional tests and checklists.
5. Only individuals that have direct knowledge and witnessed that a line item task on the prefunctional checklist was actually performed shall initial or check that item off. It is not acceptable for witnessing supervisors to fill out these forms.

F. Deficiencies, Non-Conformance and Approval in Checklists and Startup.

1. The Subs shall clearly list any outstanding items of the initial start-up and prefunctional procedures that were not completed successfully, at the bottom of the procedures form or on an attached sheet. The procedures form and any outstanding deficiencies are provided to the CxA within two days of test completion.
2. The CxA reviews the report and submits either a non-compliance report or an approval form to the Sub. The CxA shall work with the Subs and vendors to correct and retest deficiencies or uncompleted items. The CxA will involve the OR and others as necessary. The installing Subs or vendors shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner, and shall notify the CxA as soon as outstanding items have been corrected and resubmit an updated start-up report and a Statement of Correction on the original non-compliance report. When satisfactorily completed, the CxA recommends approval of the execution of the checklists and startup of each system to the OR using a standard form.
3. Items left incomplete, which later cause deficiencies or delays during functional testing may result in back charges to the responsible party. Refer to Part 3.7 herein for details.

3.5 PHASED COMMISSIONING

- A. The project will not require startup and initial checkout to be executed in phases.

3.6 FUNCTIONAL PERFORMANCE TESTING

- A. This sub-section applies to all commissioning functional testing for all divisions.
- B. The general list of equipment to be commissioned is found in Section 019113, Part 1.15.
- C. The parties responsible to execute each test are listed with each test in Sections 220800, 230800, and 260800.
- D. Objectives and Scope. The objective of functional performance testing is to demonstrate that each system is operating according to the documented design intent and Contract Documents. Functional testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation and functioning of the systems.
1. In general, each system should be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load) where there is a specified system response. Verifying each sequence in the sequences of operation is required. Proper responses to such modes and conditions as power failure, freeze condition, low oil pressure, no flow, equipment failure, etc. shall also be tested. Specific modes required in this project are given in Sections 220800, 230800, and 260800.

2. Development of Test Procedures. Before test procedures are written, the CxA shall obtain all requested documentation and a current list of change orders affecting equipment or systems, including an updated points list, program code, control sequences and parameters. Using the testing parameters and requirements in Sections 220800, 230800, and 260800.
3. The CxA shall develop specific test procedures and forms to verify and document proper operation of each piece of equipment and system. Each Sub or vendor responsible to execute a test, shall provide limited assistance to the CxA in developing the procedures review (answering questions about equipment, operation, sequences, etc.). Prior to execution, the CxA shall provide a copy of the test procedures to the Sub(s) who shall review the tests for feasibility, safety, equipment and warranty protection. The CxA may submit the tests to the A/E for review, if requested.
4. The CxA shall review owner-contracted, factory testing or required owner acceptance tests which the CxA is not responsible to oversee, including documentation format, and shall determine what further testing or format changes may be required to comply with the Specifications. Redundancy of testing shall be minimized.
5. The purpose of any given specific test is to verify and document compliance with the stated criteria of acceptance given on the test form.
- 6.

E. Test Methods.

1. Functional performance testing and verification may be achieved by manual testing (persons manipulate the equipment and observe performance) or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by stand-alone dataloggers. Sections 220800, 230800, and 260800 specify which methods shall be used for each test. The CxA may substitute specified methods or require an additional method to be executed, other than what was specified, with the approval of the OR. This may require a change order and adjustment in charge to the Owner. The CxA will determine which method is most appropriate for tests that do not have a method specified.
2. Simulated Conditions. Simulating conditions (not by an overwritten value) shall be allowed, though timing the testing to experience actual conditions is encouraged wherever practical.
3. Overwritten Values. Overwriting sensor values to simulate a condition, such as overwriting the outside air temperature reading in a control system to be something other than it really is, shall be allowed, but shall be used with caution and avoided when possible. Such testing methods often can only test a part of a system, as the interactions and responses of other systems will be erroneous or not applicable. Simulating a condition is preferable. e.g., for the above case, by heating the outside air sensor with a hair blower rather than overwriting the value or by altering the appropriate setpoint to see the desired response. Before simulating conditions or overwriting values, sensors, transducers and devices shall have been calibrated.
4. Simulated Signals. Using a signal generator which creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended over using the sensor to act as the signal generator via simulated conditions or overwritten values.
5. Altering Setpoints. Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test a sequence is acceptable. For example, to see the AC compressor lockout work at an outside air temperature below 55F, when the

- outside air temperature is above 55F, temporarily change the lockout setpoint to be 2F above the current outside air temperature.
6. Indirect Indicators. Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the tested parameters, that the indirect readings through the control system represent actual conditions and responses. Much of this verification is completed during prefunctional testing.
 7. Setup. Each function and test shall be performed under conditions that simulate actual conditions as close as is practically possible. The Sub executing the test shall provide all necessary materials, system modifications, etc. to produce the necessary flows, pressures, temperatures, etc. necessary to execute the test according to the specified conditions. At completion of the test, the Sub shall return all affected building equipment and systems, due to these temporary modifications, to their pre-test condition.
 8. Sampling. Multiple identical pieces of non-life-safety or otherwise non-critical equipment may be functionally tested using a sampling strategy. Significant application differences and significant sequence of operation differences in otherwise identical equipment invalidates their common identity. A small size or capacity difference, alone, does not constitute a difference. The specific recommended sampling rates are specified with each type of equipment in Sections 220800, 230800, and 260800. It is noted that no sampling by Subs is allowed in prefunctional checklist execution.
 - a. A common sampling strategy referenced in the *Specifications* as the “xx% Sampling—yy% Failure Rule” is defined by the following example.

xx = the percent of the group of identical equipment to be included in each sample.

yy = the percent of the sample that if failing, will require another sample to be tested.
 - b. The example below describes a 20% Sampling—10% Failure Rule.
 - 1) Randomly test at least 20% (xx) of each group of identical equipment. In no case test less than three units in each group. This 20%, or three, constitute the “first sample.”
 - 2) If 10% (yy) of the units in the first sample fail the functional performance tests, test another 20% of the group (the second sample).
 - 3) If 10% of the units in the second sample fail, test all remaining units in the whole group.
 - 4) If at any point, frequent failures are occurring and testing is becoming more troubleshooting than verification, the CxA may stop the testing and require the responsible Sub to perform and document a checkout of the remaining units, prior to continuing with functionally testing the remaining units.
- F. Coordination and Scheduling. The Subs shall provide sufficient notice to the CxA regarding their completion schedule for the prefunctional checklists and startup of all equipment and systems. The CxA will schedule functional tests through the OR, GC and affected Subs. The CxA shall direct, witness and document the functional testing of all equipment and systems. The Subs shall execute the tests.
1. In general, functional testing is conducted after prefunctional testing and startup has been satisfactorily completed. The control system is sufficiently tested and approved by the CxA before it is used for TAB or to verify performance of other components or systems. The air balancing and water balancing is completed and debugged before functional testing of air-related or water-related equipment or systems. Testing proceeds from

components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems is checked.

- G. Test Equipment. Refer to Section 019113, Part 2 for test equipment requirements.
- H. Problem Solving. The CxA will recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the GC, Subs and A/E.

3.7 DOCUMENTATION, NON-CONFORMANCE AND APPROVAL OF TESTS

- A. Documentation. The CxA shall witness and document the results of all functional performance tests using the specific procedural forms developed for that purpose. Prior to testing, these forms are provided to the OR for review and approval and to the Subs for review. The CxA will include the filled out forms in the O&M manuals.
- B. Non-Conformance.
 - 1. The CxA will record the results of the functional test on the procedure or test form. All deficiencies or non-conformance issues shall be noted and reported to the OR on a standard non-compliance form.
 - 2. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CxA. In such cases the deficiency and resolution will be documented on the procedure form.
 - 3. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the CxA will not be pressured into overlooking deficient work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so at the request of the OR.
 - 4. As tests progress and a deficiency is identified, the CxA discusses the issue with the executing contractor.
 - a. When there is no dispute on the deficiency and the Sub accepts responsibility to correct it:
 - 1) The CxA documents the deficiency and the Sub's response and intentions and they go on to another test or sequence. After the day's work, the CxA submits the non-compliance reports to the OR for signature, if required. A copy is provided to the Sub and CxA. The Sub corrects the deficiency, signs the statement of correction at the bottom of the non-compliance form certifying that the equipment is ready to be retested and sends it back to the CxA.
 - 2) The CxA reschedules the test and the test is repeated.
 - b. If there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible:
 - 1) The deficiency shall be documented on the non-compliance form with the Sub's response and a copy given to the OR and to the Sub representative assumed to be responsible.
 - 2) Resolutions are made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive authority is with the A/E. Final acceptance authority is with the Project Manager.

- 3) The CxA documents the resolution process.
 - 4) Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency, signs the statement of correction on the non-compliance form and provides it to the CxA. The CxA reschedules the test and the test is repeated until satisfactory performance is achieved.
 5. Cost of Retesting.
 - a. The cost for the *Sub* to retest a prefunctional or functional test, if they are responsible for the deficiency, shall be theirs. If they are not responsible, any cost recovery for retesting costs shall be negotiated with the GC.
 - b. For a deficiency identified, not related to any prefunctional checklist or start-up fault, the following shall apply: The CxA and OR will direct the retesting of the equipment once at no “charge” to the GC for their time. However, the CxA’s time for a second retest will be charged to the GC, who may choose to recover costs from the responsible Sub.
 - c. The time for the CxA and OR to direct any retesting required because a specific *prefunctional* checklist or start-up test item, reported to have been successfully completed, but determined during functional testing to be faulty, will be backcharged to the GC, who may choose to recover costs from the party responsible for executing the faulty prefunctional test.
 - d. Refer to the sampling section of Section 019113, Part 3.6 for requirements for testing and retesting identical equipment.
 6. The Contractor shall respond in writing to the CxA at least as often as commissioning meetings are being scheduled concerning the status of each apparent outstanding discrepancy identified during commissioning. Discussion shall cover explanations of any disagreements and proposals for their resolution.
 7. The CxA retains the original non-conformance forms until the end of the project.
 8. Any required retesting by any contractor shall not be considered a justified reason for a claim of delay or for a time extension by the prime contractor.
- C. Failure Due to Manufacturer Defect. If 10%, or five, whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform to the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance spec, all identical units may be considered unacceptable by the OR. In such case, the Contractor shall provide the Owner with the following:
1. Within one week of notification from the OR, the Contractor or manufacturer’s representative shall examine all other identical units making a record of the findings. The findings shall be provided to the OR within two weeks of the original notice.
 2. Within two weeks of the original notification, the Contractor or manufacturer shall provide a signed and dated, written explanation of the problem, cause of failures, etc. and all proposed solutions which shall include full equipment submittals. The proposed solutions shall not significantly exceed the specification requirements of the original installation.
 3. The OR will determine whether a replacement of all identical units or a repair is acceptable.
 4. Two examples of the proposed solution will be installed by the Contractor and the OR will be allowed to test the installations for up to one week, upon which the OR will decide whether to accept the solution.
 5. Upon acceptance, the Contractor and/or manufacturer shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.

- D. Approval. The CxA notes each satisfactorily demonstrated function on the test form. Formal approval of the functional test is made later after review by the CxA and by the OR, if necessary. The CxA recommends acceptance of each test to the OR using a standard form. The OR gives final approval on each test using the same form, providing a signed copy to the CxA and the Contractor.

3.8 DEFERRED TESTING

- A. Unforeseen Deferred Tests. If any check or test cannot be completed due to the building structure, required occupancy condition or other deficiency, execution of checklists and functional testing may be delayed upon approval of the OR. These tests will be conducted in the same manner as the seasonal tests as soon as possible. Services of necessary parties will be negotiated.
- B. Seasonal Testing. During the warranty period, seasonal testing (tests delayed until weather conditions are closer to the system's design) shall be completed as part of this contract. The CxA shall coordinate this activity. Tests will be executed, documented and deficiencies corrected by the appropriate Subs, with facilities staff and the CxA witnessing. Any final adjustments to the O&M manuals and as-builds due to the testing will be made.

3.9 TRAINING OF OWNER PERSONNEL

- A. The GC shall be responsible for training coordination and scheduling and ultimately for ensuring that training is completed.
- B. The CxA shall be responsible for overseeing and approving the content and adequacy of the training of Owner personnel for commissioned equipment.
 - 1. The CxA shall interview the facility manager and lead engineer to determine the special needs and areas where training will be most valuable. The Owner and CxA shall decide how rigorous the training should be for each piece of commissioned equipment. The CxA shall communicate the results to the Subs and vendors who have training responsibilities. In addition to these general requirements, the specific training requirements of Owner personnel by Subs and vendors are specified in Division 22, 23, 26, and 28.
 - 2. Each Sub and vendor responsible for training will submit a written training plan to the CxA for review and approval prior to training. The plan will cover the following elements:
 - a. Equipment (included in training)
 - b. Intended audience
 - c. Location of training
 - d. Objectives
 - e. Subjects covered (description, duration of discussion, special methods, etc.)
 - f. Duration of training on each subject
 - g. Instructor for each subject
 - h. Methods (classroom lecture, video, site walk-through, actual operational demonstrations, written handouts, etc.)
 - i. Instructor and qualifications
 - j. For the primary HVAC equipment, the Controls Contractor shall provide a short discussion of the control of the equipment during the mechanical or electrical training conducted by others.

3. The CxA develops an overall training plan and coordinates and schedules, with the OR and GC, the overall training for the commissioned systems. The CxA develops criteria for determining that the training was satisfactorily completed, including attending some of the training, etc. The CxA recommends approval of the training to the OR using a standard form. The OR also signs the approval form at one of the training sessions, the CxA presents a one hour presentation discussing the use of the blank functional test forms for re-commissioning equipment. Video recording of the training sessions will be provided by the Trade Contractor with media cataloged by the CxA and added to the O&M manuals.
4. The mechanical design engineer shall at the first training session present the overall system design concept and the design concept of each equipment section. This presentation shall be one to two hours in length and include a review of all systems using the simplified system schematics (one-line drawings) including chilled water systems, condenser water, heating systems, gas supply systems, supply air systems, exhaust system and outside air strategies.

3.10 OPERATION AND MAINTENANCE MANUALS

A. Standard O&M Manuals.

1. The specific content and format requirements for the standard O&M manuals are detailed in Section 017823.
2. Contractor shall submit draft copies of the complete operating and maintenance manual to the OR for review by the architect/engineer and CxA within 60 calendar days after review of equipment shop drawings. One copy will be returned to the contractor within 30 days after receipt by the A/E. Digital copies preferred.
3. Contractor shall submit corrected final approved manuals prior to substantial completion. Prior to final submittal, the CxA shall review the O&M manuals (in addition to the initial draft O&M manual), and documentation, with redline as-builts, for systems that were commissioned to verify compliance with the specifications. The CxA will communicate, through the OR, deficiencies in the manuals to the contractor or A/E, as requested. Upon a successful review of the corrections, the CxA will recommend approval and acceptance of these sections of the O&M manuals to the OR. The CxA will also review each equipment warranty and verify that all requirements to keep the warranty valid are clearly stated. This work does not supersede the A/E's review of the O&M manuals according to the A/E's contract.
4. A/E Contribution. The A/E will include in the beginning of the O&M manuals a separate section describing the systems including:
 - a. The design intent narrative prepared by the A/E and provided as part of the bid documents, updated to as-built status by the A/E.
 - b. Simplified professionally drawn single line system diagrams on 8 ½" x 11" or 11" x 17" sheets. These shall include chillers, water system, condenser water system, heating system, supply air systems, exhaust systems and electrical distribution system. These shall show major pieces of equipment such as pumps, chillers, boilers, control valves, expansion tanks, coils, service valves, switchboards, motor control centers, panel boards, etc.
5. CxA Review and Approval. Prior to substantial completion, the CxA shall review the O&M manuals, documentation and redline as-builts *for systems that were commissioned*

to verify compliance with the *Specifications*. The CxA will communicate deficiencies in the manuals to the OR or A/E, as requested. Upon a successful review of the corrections, the CxA recommends approval and acceptance of these sections of the O&M manuals to the OR or A/E. The CxA also reviews each equipment warranty and verifies that all requirements to keep the warranty valid are clearly stated. This work does not supersede the A/E's review of the O&M manuals according to the A/E's contract.

B. Commissioning Record in O&M Manuals.

1. The CxA is responsible to compile, organize and index the following commissioning data by equipment into hyperlinked PDF and deliver it to the GC, to be included with the O&M manuals. Digital Hyperlinked PDF will be submitted. Hard copy upon request.

The format of the manuals shall be:

<i>Tab I-1</i>	Commissioning Plan
<i>Tab I-2</i>	Final Commissioning Report (see (B.2) below)
<i>Tab 01</i>	System Type 1 (chiller system, packaged unit, boiler system, etc.)
<i>Sub-Tab A</i>	Design narrative and criteria, sequences, approvals for Equipment 1
<i>Sub-Tab B</i>	Startup plan and report, approvals, corrections, blank prefunctional checklists <i>Colored Separator Sheets</i> —for each equipment type (fans, pumps, chiller, etc.)
<i>Sub-Tab C</i>	Functional tests (completed), trending and analysis, approvals and corrections, training plan, record and approvals, blank functional test forms and a recommended recommissioning schedule.
<i>Tab 02</i>	System Type 2.....repeat as per System 1

2. Final Report Details. The final commissioning report shall include an executive summary, list of participants and roles, brief building description, overview of commissioning and testing scope and a general description of testing and verification methods. For each piece of commissioned equipment, the report should contain the disposition of the commissioning authority regarding the adequacy of the equipment, documentation and training meeting the contract documents in the following areas: 1) Equipment meeting the equipment specifications, 2) Equipment installation, 3) Functional performance and efficiency, 4) Equipment documentation and design intent, and 5) Operator training. All outstanding non-compliance items shall be specifically listed. Recommendations for improvement to equipment or operations, future actions, commissioning process changes, etc. shall also be listed. Each non-compliance issue shall be referenced to the specific functional test, inspection, trend log, etc. where the deficiency is documented. The functional performance and efficiency section for each piece of equipment shall include a brief description of the verification method used (manual testing, BAS trend logs, data loggers, etc.) and include observations and conclusions from the testing.

3. Other documentation will be retained by the CxA

3.11 WRITTEN WORK PRODUCTS

- A. The commissioning process generates a number of written work products described in various parts of the *Specifications*. The *Commissioning Plan—Construction Phase*, lists all the formal

written work products, describes briefly their contents, who is responsible to create them, their due dates, who receives and approves them and the location of the specification to create them. In summary, the written products are:

<u>Product</u>	<u>Developed By</u>
1. Final commissioning plan	CxA
2. Cx meeting minutes	CxA
3. Commissioning schedules	CxA with GC
4. Equipment documentation submittals	Subs
5. Sequence clarifications	Subs and A/E as needed
5. Prefunctional checklists	CxA
6. Startup and initial checkout plan	Subs and CxA (compilation of existing documents)
7. Startup and initial checkout forms filled out	Subs
8. Final TAB report	TAB
9. Issues log (deficiencies)	CxA
10. Commissioning Progress Record	CxA
11. Deficiency reports	CxA
12. Functional test forms	CxA
13. Filled out functional tests	CxA
14. O&M manuals	Subs
15. Commissioning record book	CxA
16. Overall training plan	CxA and OR
17. Specific training agendas	Subs
18. Final commissioning report	CxA
19. Misc. approvals	CxA

END OF SECTION 01 91 13

NC State University Design and Construction Guidelines

Division 02 Waste Materials Management – Reuse, Recycling, & Hazardous Waste

1.1 Purpose

- A. The following guidelines define waste management and disposal responsibilities for both hazardous and non-hazardous construction and demolition (C&D) wastes. The guidelines also address performance and reporting requirements.

2.0 General Requirements

A. Definitions

1. Construction & Demolition Waste: Building and site improvement materials, and other solid waste resulting from construction, demolition, renovation, or repair operations. Material stream also includes brick, concrete, asphalt, and aggregate.
2. Special Waste: Solid wastes that require special handling and management.
3. Hazardous Waste: Any solid waste that is ignitable, corrosive, reactive, or toxic; a listed hazardous material or containing a listed hazardous material per Title 40 Code of Federal Regulations Parts 260-270.
4. Universal Waste: Hazardous wastes that have been provided specific exemptions (40 CFR 273) to encourage recycling. Universal wastes are limited to recalled or cancelled pesticides and intact batteries, lamps, and mercury containing devices. State regulations prohibit the crushing of fluorescent lamps.
5. Salvage: Recovery of waste for reuse in the existing facility, a different facility, subsequent sale as State Surplus property, or other reuse efforts.
6. Recycle: Recovery of waste for processing and preparation into products or raw materials.
7. Yard waste: A solid waste consisting solely of vegetative matter resulting from landscaping maintenance.

B. Performance Goals and Requirements

1. All hazardous and non-hazardous generated waste shall be managed in accordance with local, state, and federal regulations.
2. Seventy-five percent (75%) of a project's non-hazardous waste must be diverted from landfill disposal through reuse and recycling.
3. One hundred percent (100%) of yard waste must be diverted from landfill disposal through reuse and recycling.
4. The Designer must complete the Designer Waste Information Form (<http://go.ncsu.edu/wasteinfoform>) and identify regulated wastes, as well as materials, fixtures, and equipment that are to be salvaged for reuse or recycled. The location of the staging area as well as the responsible party for removal, delivery, and/or pick up must also be included.
5. The completed **Designer Waste Information Form must be included in the Construction Documents** that go out for review and bid.
6. The Contractor must provide a Waste Management Plan (<http://go.ncsu.edu/wastemanagementplan>) to NC State for approval prior to implementing work. The plan shall include details on how the hazardous and non-hazardous generated waste will be managed in accordance with local, state, and federal regulations. Contractor must also provide all

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materials, personnel, and protective equipment necessary to remove and store wastes in accordance with the plan. The Contractor must coordinate salvage or reuse efforts identified on the Designer Waste Information Form with NC State and/or the non-profit entity.

C. Reporting Requirements

1. Hazardous Waste

a) The Contractor must provide NC State with a copy of all hazardous, universal, and special waste disposal certifications and/or manifests for all waste shipped.

2. Non-Hazardous C&D Waste

a) All reuse, recycling, and landfilled materials are to be tracked and complied on NC State's tracking forms, which can be found at <https://recycling.ncsu.edu/wp-content/uploads/sites/3/2018/04/CD-Tracking-forms-for-upload.pdf>. The completed form, with weight tickets/invoices attached, is considered a required close-out document and must be submitted before final payment is issued.

3.0 Management of Hazardous, Universal, and Special Wastes

A. Hazardous, universal, and special wastes must be managed separately from other C&D wastes.

B. Disposal must be coordinated with NC State Environmental Health & Safety.

C. Special wastes include:

1. Paints, varnish, solvents, sealers, thinners, resins, roofing cement, adhesives, lubricants, and caulk, or drums and containers that once held these materials.
2. Treated wood including lumber, posts, ties, decks, and utility poles (creosote, arsenic, chromium, pentachlorophenol).
3. Asbestos, PCBs, mercury, or lead containing materials
4. Used oil
5. Lead acid batteries
6. Medical wastes

D. Waste disposal responsibility falls to one of two parties: the Contractor or NC State, as defined in the NC State Environmental Health and Safety's document:

Management of Building Demolition Debris available at: <http://go.ncsu.edu/demodebris>

1. Containers used for waste storage must be United States Department of Transportation approved. The Contractor must supply bins, tanks or tank trucks. Containers must remain closed at all times except when material is being added. NC State will provide containers for items collected by NC State.
2. Hazardous waste containers must have labels that clearly identify waste streams. Different waste streams cannot be combined in a shared container. The Contractor must identify the initial accumulation date on

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- the hazardous waste label when waste is first placed in the container.
3. Waste containers must be stored in a secured, covered, and well identified area of the construction site. Hazardous waste cannot be stored for more than 90 days. Any waste stored for more than six days must be inspected, and the inspection documented, weekly.
 4. Spill response supplies must be on-site and adequate to contain 110% of any accumulated waste. Portable fire extinguishers must also be readily available. If a spill occurs, Contractor must contact NC State immediately and proceed with spill containment and clean up.
 5. The Contractor must provide NC State with a copy of all hazardous, universal, and special waste disposal certifications and/or manifests for all waste shipped.

4.0 Management of Non-Hazardous Waste

- A. Priority 1 - Salvage of Construction and Demolition Waste for Reuse
1. Salvaged materials should first be evaluated for use in University construction projects. NC State Surplus Property Services should be considered if there are reusable materials that have resale value and are no longer needed by the University. Contact Waste Reduction and Recycling (ajbensle@ncsu.edu) for assistance with disposition.
Examples of Salvageable material include:
 - a) Furniture and electronics
 - b) Cabinets and shelves that are not built-in
 - c) Sinks and water fountains
 - d) Paper towel dispensers
 - e) Newer light fixtures
 - f) Dry erase boards, chalkboards, and cork boards
 - g) Solid wood panel doors
 - h) Brick pavers
 2. Contact vendors about take-back programs to recycle materials their company provides. These materials include, but are not limited to ceiling tiles, carpet tiles, and cubicle walls.
 3. Coordinate with the Project Manager to utilize the [NC State Construction Shop](#) for the careful removal of salvageable items prior to contractor demolition. An estimate for the Construction Shop's work must be received during design and must be initiated prior to the project going out to bid.
- B. Priority 2 - Recycling of Construction and Demolition Waste
1. If materials are not a salvageable for reuse, they must be source separated to the greatest extent possible and recycled.
 2. Common source separated materials for recycling include:
 - a) Cardboard
 - b) Bottles and cans
 - c) Scrap metal and wire

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- d) Rigid plastics
 - e) Untreated/unpainted dimensional lumber
 - f) Gypsum board (unpainted)
 - g) Concrete
 - h) Asphalt (pavement and shingles)
 - i) Aggregate
 - j) Brick and CMU
3. 100% of the following materials must be recycled:
- a) Cardboard
 - b) Bottles and cans
 - c) Scrap metal and wire
 - d) Concrete
 - e) Asphalt (pavement and shingles)
 - f) Aggregate
 - g) Brick and CMU
 - h) Designer shall coordinate with Waste Reduction and Recycling office during design to properly coordinate selective demolition requirements and recycling goals.**
- C. Priority 3 - Disposal of Construction and Demolition Waste
- 1. If material/s cannot be salvaged for reuse or source separated and recycled, they must be sent to a C&D recycling and reclamation facility. Materials are not to be sent directly to a landfill or a facility that does not sort and recycle.
- D. All solid waste management facilities must be permitted to operate by NCDEQ in accordance with [15A NCAC 13B .0201](#).
- E. University Contract Pricing**
- 1. When available, the contractor may utilize University contract pricing for related facility tip costs or recycling rebates. In order to utilize contracts, contractor must coordinate with the University project manager and Waste Reduction and Recycling office.
- F. University Rolloff Services
- 1. Depending upon the scale of the work, dumpster services can be provided for Informal or Formal construction projects. Coordinate with NCSU Waste Reduction and Recycling to provide 17-20 cubic yard rollofs. Rental and contact information; <https://recycling.ncsu.edu/rentals/>

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.

B. Related Requirements:

1. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 013000 "NC State Contractor Safety Requirements."
3. Section 017300 "Execution" for cutting and patching procedures.
4. Section 017419 "Construction Waste Management and Disposal."

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and store.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

1.3 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.4 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.
1. Inspect and discuss condition of construction to be selectively demolished.
 2. Review structural load limitations of existing structure.
 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.

4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.5 INFORMATIONAL SUBMITTALS

- A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.
- B. Schedule of selective demolition activities with starting and ending dates for each activity.
- C. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician.

1.6 CLOSEOUT SUBMITTALS

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

1.7 QUALITY ASSURANCE

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

1.8 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 1. Maintain fire-protection facilities in service during selective demolition operations.

1.9 WARRANTY

- A. Existing Warranties: Remove, replace, patch and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties.

1.10 COORDINATION

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.
- C. University Requirements: Comply with all NCSU Design and Construction Guidelines, including Section 013000 "Contractor Safety Requirements."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
 - 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 PREPARATION

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

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

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

3.4 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 - 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of selective demolition.

- C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 - 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 - 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 - 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 - 5. Maintain fire watch during and for at least two hours after flame-cutting operations.
 - 6. Maintain adequate ventilation when using cutting torches.
 - 7. Remove decayed, vermin-infested or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 - 8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 - 9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 - 10. Dispose of demolished items and materials promptly. Comply with requirements in Section 017419 "Construction Waste Management and Disposal."
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways and other adjacent occupied and used facilities.
- C. Removed and Salvaged Items:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to Owner's storage area designated by Owner.
 - 5. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items:
 - 1. Clean and repair items to functional condition adequate for intended reuse.
 - 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 - 3. Protect items from damage during transport and storage.
 - 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports and miscellaneous materials necessary to make item functional for use indicated.

- E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
- B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- C. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Remove debris from elevated portions of building by chute, hoist or other device that will convey debris to grade level in a controlled descent.
 - 4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.

3.8 CLEANING

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

END OF SECTION 024119

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete standards.
2. Concrete materials.
3. Admixtures.
4. Fiber reinforcement.
5. Vapor retarders.
6. Floor and slab treatments.
7. Liquid floor treatments.
8. Curing materials.
9. Accessories.
10. Repair materials.
11. Concrete mixture materials.
12. Concrete mixture class types.
13. Concrete mixing.

B. Related Requirements:

1. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement or blended hydraulic cement alone or in combination with one or more of the following:

1. Fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. Water/Cementitious Materials (w/cm) Ratio: The ratio by weight of mixing water to cementitious materials.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Portland cement.
2. Aggregates.
3. Admixtures:
 - a. Include limitations of use. Admixtures that do not comply with reference ASTM International requirements must be submitted with test data for approval.
4. Floor and slab treatments.
5. Liquid floor treatments.
6. Curing materials.

B. Design Mixtures: For each concrete mixture, include the following:

1. Mixture identification.
2. Compressive strength at 28 days or other age as specified.
3. Maximum w/cm ratio.
4. Slump or slump flow limit.
5. Air content.
6. Nominal maximum aggregate size.
7. Intended placement method.
8. Submit adjustments to design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant changes.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the following:

1. Installer: Include copies of applicable ACI certificates.
2. Testing Agency: Include documentation indicating compliance with ASTM E329 or ASTM C1077 and copies of applicable ACI certificates for testing technicians or ACI Concrete Construction Special Inspector - MH, ASCC.

B. Material Certificates: For each of the following:

1. Cementitious materials.
2. Admixtures.
3. Curing compounds.
4. Floor and slab treatments.

C. Material Test Reports: For the following:

1. Portland cement.
2. Aggregates.
3. Admixtures.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified Installer who employs Project personnel qualified as an ACI-certified Concrete Flatwork Associate and Concrete Flatwork Finisher and a supervisor who is a certified ACI Advanced Concrete Flatwork Finisher/Technician or an ACI Concrete Flatwork Finisher with experience installing and finishing concrete.
- B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
- C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing that performs duties on behalf of the Architect/Engineer.
- D. Field Quality-Control Testing Agency Qualifications: An independent agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with ASTM C94/C94M and ACI 301.

PART 2 - PRODUCTS

2.1 CONCRETE STANDARDS

- A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

- A. Cementitious Materials:
 - 1. Portland Cement: ASTM C150/C150M, **Type I**.
- B. Normal-Weight Aggregates:
 - 1. Coarse Aggregate: ASTM C33/C33M
 - 2. Fine Aggregate: ASTM C33/C33M.

2.3 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C260/C260M.

2.4 FLOOR AND SLAB TREATMENTS

- A. Coordinate with architect.

2.5 LIQUID FLOOR TREATMENTS

- A. Coordinate with architect.

2.6 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
- D. Water: Potable water that does not cause staining of the surface.

2.7 CONCRETE MIXTURE MATERIALS

- 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, in accordance with ACI 301.
 - 1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.
- B. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
- C. Color Pigment: Coordinate with architect.

2.8 CONCRETE MIXTURE CLASS TYPES

- A. Class D: Light-weight concrete used for interior suspended slabs.
 - 1. Minimum Compressive Strength: **4000 psi at 28 days**.

2.9 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M and furnish delivery ticket.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions:
 - 1. Before placing concrete, verify that installation of concrete forms, accessories, reinforcement, and embedded items is complete and that required inspections have been performed.
 - 2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:
 - 1. Daily access to the Work.
 - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 - 3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
 - 4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 TOLERANCES

- A. Comply with ACI 117.

3.4 INSTALLATION OF 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.
 - 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.5 INSTALLATION OF CAST-IN-PLACE CONCRETE

- A. Before placing concrete, verify that installation of formwork, reinforcement and embedded items that required inspections are completed.
- B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Water addition in transit or at the Project site must be in accordance with ASTM C94/C94M and must not exceed the permitted amount indicated on the concrete delivery ticket.
- D. Deposit concrete continuously in one layer.
 - 1. Deposit concrete to avoid segregation.
 - 2. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
 - a. Do not use vibrators to transport concrete inside forms.
 - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
 - c. 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.

3.6 APPLICATION OF FINISHING FLOORS AND SLABS

- A. Coordinate with architect.
 - a. Suspended Slabs:
 - 1) Specified overall values of flatness, F_F 35; and of levelness, F_L 20; with minimum local values of flatness, F_F 24; and of levelness, F_L 15.

3.7 APPLICATION OF CONCRETE CURING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
 - 1. Comply with ACI 301 for cold weather protection during curing.
 - 2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
 - 3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h, calculated in accordance with ACI 305R, before and during finishing operations.
- B. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:

1. Begin curing after finishing concrete.
2. Interior Concrete Floors:
 - a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12 inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 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.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.
 - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following not in cold weather:
 - a) Water.
 - b) Continuous water-fog spray.
 - b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12 inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 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.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.
 - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.

- b) Continuous water-fog spray.
- c. Floors To Receive Chemical Stain:
 - 1) As soon as concrete has sufficient set to permit application without marring concrete surface, install curing paper over entire area of floor.
 - 2) Install curing paper square to building lines, without wrinkles, and in a single length without end joints.
 - 3) Butt sides of curing paper tight; do not overlap sides of curing paper.
 - 4) Leave curing paper in place for duration of curing period, but not less than 28 days.
- d. Floors To Receive Curing Compound:
 - 1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
 - 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
 - 3) Maintain continuity of coating, and repair damage during curing period.
 - 4) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.
- e. Floors To Receive Curing and Sealing Compound:
 - 1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.
 - 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
 - 3) Repeat process 24 hours later, and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

3.8 APPLICATION OF LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment in accordance with manufacturer's written instructions.
 - 1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 - 2. Do not apply to concrete that is less than **28** days' old, or as specified by Manufacturer.
 - 3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.
 - 4. Rinse with water; remove excess material until surface is dry.
 - 5. Apply a second coat in a similar manner if surface has received a float finish or abrasive surface preparation.
- B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller in accordance with manufacturer's written instructions.

3.9 INSTALLATION OF CONCRETE SURFACE REPAIRS

- A. Defective Concrete:

1. Repair and patch defective areas when approved by Architect.
2. Remove and replace concrete that cannot be repaired and patched to meet specification requirements.

B. Repairing Unformed Surfaces:

1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
 - a. Correct low and high areas.
 - b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
2. Repair finished surfaces containing surface defects, including 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.
3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during, or immediately after, completing surface-finishing operations by adding patching mortar.
 - a. Finish repaired areas to blend into adjacent concrete.
5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
 - a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - b. Feather edges to match adjacent floor elevations.
6. Correct other low areas scheduled to remain exposed with repair topping.
 - a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
 - b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.
 - a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
 - b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
 - c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
 - d. Place, compact, and finish to blend with adjacent finished concrete.
 - e. Cure in same manner as adjacent concrete.
8. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.
 - a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
 - b. Dampen cleaned concrete surfaces and apply bonding agent.

- c. Place patching mortar before bonding agent has dried.
 - d. Compact patching mortar and finish to match adjacent concrete.
 - e. Keep patched area continuously moist for at least 72 hours.
- C. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: **Owner will engage** a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
 - 1. Testing agency to be responsible for providing curing facility for initial curing of strength test specimens on-site and verifying that test specimens are cured in accordance with standard curing requirements in ASTM C31/C31M.
 - 2. Testing agency to immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
 - 3. Testing agency to report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
 - a. Test reports to include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:
 - 1) Project name.
 - 2) Name of testing agency.
 - 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
 - 4) Name of concrete manufacturer.
 - 5) Date and time of inspection, sampling, and field testing.
 - 6) Date and time of concrete placement.
 - 7) Location in Work of concrete represented by samples.
 - 8) Date and time sample was obtained.
 - 9) Truck and batch ticket numbers.
 - 10) Design compressive strength at 28 days.
 - 11) Concrete mixture designation, proportions, and materials.
 - 12) Field test results of fresh concrete, including slump or slump flow, air content, temperature and density.
 - 13) Information on storage and curing of samples at the Project site, including curing method and maximum and minimum temperatures during initial curing period.
 - 14) Type of fracture and compressive break strengths at seven days and 28 days.
 - 4. Provide a space and source of power or other resources for curing and access to test specimens by the testing agency.
- B. Delivery Tickets: comply with ASTM C94/C94M.
- C. Inspections:
 - 1. Headed bolts and studs.
 - 2. Verification of use of required design mixture.
 - 3. Concrete placement, including conveying and depositing.

4. Curing procedures and maintenance of curing temperature.
 5. Verification of concrete strength before removal of shores and forms from beams and slabs.
 6. Batch Plant Inspections: On a random basis, as determined by Architect.
- D. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M to be performed in accordance with the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 150 cu. yd. or fraction thereof.
 - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing is to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Concrete Density: ASTM C138/C138M:
 - a. One test for each composite sample when strength test specimens are cast.
 3. Unit Weight: ASTM C138/C138M density of fresh structural lightweight concrete.
 - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture. The fresh density should be consistent with that associated with the equilibrium density within a tolerance of plus or minus 4 lb/ft.³.
 4. Compression Test Specimens: ASTM C31/C31M:
 - a. Cast and standard cure two sets of two 6 inches by 12-inches or 4-inch by 8-inch cylindrical specimens for each composite sample.
 - b. Cast, and field cure two sets of two standard cylindrical specimens for each composite sample.
 5. Compressive-Strength Tests: ASTM C39/C39M.
 - a. Test one set of two standard cured specimens at seven days and one set of two specimens at 28 days.
 - b. Test one set of two field-cured specimens at seven days and one set of two specimens at 28 days.
 - c. A compressive-strength test to be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
 6. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor to evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
 7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests of standard cured cylinders equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
 8. 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.
 9. Additional Tests:

- a. Testing and inspecting agency to 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.
 - b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
 - 1) Acceptance criteria for concrete strength to be in accordance with ACI 301, Section 1.7.6.3.
- 10. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- 11. 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 in accordance with ASTM E1155 within **72** hours of completion of floor finishing and promptly report test results to Architect.

3.11 PROTECTION

- A. Protect concrete surfaces as follows:
 - 1. Protect from petroleum stains.
 - 2. Diaper hydraulic equipment used over concrete surfaces.
 - 3. Prohibit vehicles from interior concrete slabs.
 - 4. Prohibit use of pipe-cutting machinery over concrete surfaces.
 - 5. Prohibit placement of steel items on concrete surfaces.
 - 6. Prohibit use of acids or acidic detergents over concrete surfaces.
 - 7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
 - 8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using floor slab protective covering.

END OF SECTION 033000

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural-steel materials.
2. Shear stud connectors.

B. Related Requirements:

1. Section 053100 "Steel Decking" for field installation of shear stud connectors through deck.

1.2 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.
- B. 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.
- C. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

A. Product Data:

1. Structural-steel materials.
2. High-strength, bolt-nut-washer assemblies.
3. Shear stud connectors.
4. Anchor rods.
5. Shop primer.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.

2. Include embedment Drawings.
 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
 5. Identify members not to be shop primed.
- C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide in accordance with AWS D1.1/D1.1M for each welded joint.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For **Installer, shop-painting applicators, testing agency.**
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Mill test reports for structural-steel materials, including chemical and physical properties.
- E. Product Test Reports: For the following:
 1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
 2. Shear stud connectors.
- F. Survey of existing conditions.
- G. Source quality-control reports.
- H. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).
- B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector.
- C. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with applicable provisions of the following specifications and documents:
 - 1. ANSI/AISC 303.
 - 2. RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- B. Connection Design Information:
 - 1. Connection designs have been completed and connections indicated on the Drawings.

2.2 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: **ASTM A572/A572M, Grade 50.**
- B. Channels, Angles, M-Shapes: **ASTM A36/A36M**
- C. Plate and Bar: **ASTM A36/A36M.**
- D. Cold-Formed Hollow Structural Sections: **ASTM A500/A500M, Grade B** structural tubing.
- E. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

- A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325. If using corrosion-resisting (weathering) steel, revise Type 1 bolts and washers to Type 3 and Grade DH nuts to Grade DH3 (Class 10S to Class 10S3) in "High-Strength A490 Bolts, Nuts, and Washers" Paragraph below. Retain option below if applicable.
- B. Holo bolts are by Lindapter.
- C. Titen screws are by Simpson.
- D. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

2.4 PRIMER

- A. Steel Primer:
 - 1. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
 - 1. Camber structural-steel members where indicated.
 - 2. Fabricate beams with rolling camber up.
 - 3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
 - 4. Mark and match-mark materials for field assembly.
 - 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, **[mechanically thermal cut,**]or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with **SSPC-SP 1**.

- F. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.
- G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
 - 1. Cut, drill, or punch holes perpendicular to steel surfaces.[**Do not thermally cut bolt holes or enlarge holes by burning.**]
 - 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: **Snug tightened.**
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

2.7 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 - 2. Surfaces to be field welded.
 - 3. Surfaces of high-strength bolted, slip-critical connections.
 - 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 - 5. Surfaces enclosed in interior construction.
- B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standard:
 - 1. SSPC-SP 2.
- C. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a

minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.8 SOURCE QUALITY CONTROL

- A. Testing Agency: **Owner will engage** a qualified testing agency to perform shop tests and inspections.
1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
 2. Bolted Connections: Inspect shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M
 4. In addition to visual inspection, test and inspect shop-welded shear stud connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear stud connector.
 - b. Conduct tests in accordance with requirements in AWS D1.1/D1.1M on additional shear stud connectors if weld fracture occurs on shear stud connectors already tested.
 5. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.
 - 1. Do not remove temporary shoring supporting composite deck construction and structural-steel framing until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.
- B. Baseplates, Bearing Plates, and Leveling 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.
- C. Maintain erection tolerances of structural steel within ANSI/AISC 303.
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection[**unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1.**
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.

1. Joint Type: **Snug tightened.**
- B. Weld Connections: Comply with AWS D1.1/D1.1M[and **AWS D1.8/D1.8M**] for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
- C. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.
- D. Touchup Painting:
 1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: **Owner will engage** a qualified testing agency to perform tests and inspections.
 1. Bolted Connections: Inspect bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 2. Shear Stud Connectors: In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - b. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

END OF SECTION 051200

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Composite floor deck.
- B. Related Requirements:
 - 1. See General Structural Notes on structural drawings for concrete slab and reinforcing requirements.
 - 2. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. Composite floor deck.
- 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.

1.3 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product Certificates: For each type of steel deck.
- C. Test and Evaluation Reports:
 - 1. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
 - a. Power-actuated mechanical fasteners.
- D. Field Quality-Control Submittals:
 - 1. Field quality-control reports.
- E. Qualification Statements: For **welding personnel and testing agency**.

1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with SDI QA/QC and the following welding codes:

1. AWS D1.1/D1.1M.
2. AWS D1.3/D1.3M.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Store products in accordance with SDI MOC3. 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 in accordance with AISI S100.
- B. Fire-Resistance Ratings: Comply with ASTM E119; 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 listings of another qualified testing agency.

2.2 COMPOSITE FLOOR DECK

- A. Fabrication of Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with SDI C, with the minimum section properties indicated, and with the following:
 1. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 33, [30 zinc coating.
 2. Profile Depth: **As indicated.**
 3. Design Uncoated-Steel Thickness: as indicated.
 4. Span Condition: as indicated.

2.3 ACCESSORIES

- A. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile **recommended by SDI standards for overhang and slab depth**.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- H. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
- I. Galvanizing Repair Paint: **MIL-P-21035B, with dry film containing a minimum of 94 percent zinc dust by weight**].
- J. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

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 of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories in accordance with SDI C, SDI NC, and SDI RD, as applicable; manufacturer's written instructions; and requirements in this Section.
- B. Locate deck bundles to prevent overloading of supporting members.
- C. 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.
- D. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- E. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- F. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- G. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- H. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install in accordance with deck manufacturer's written instructions.

- I. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

3.3 INSTALLATION OF FLOOR DECK

- A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
 1. Weld Diameter: **5/8 inch**, nominal.
 2. Weld Spacing: as indicated.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 36 inches, and as follows:
 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
 2. Mechanically clinch or button punch.
 3. Fasten with a minimum of 1-1/2-inch-long welds.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of **[1-1/2 inches]** with end joints as follows:
 1. End Joints: **Lapped**.
- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure in accordance with SDI recommendations unless otherwise indicated.
- E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, in accordance with SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.4 REPAIR

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint in accordance with ASTM A780/A780M and manufacturer's written instructions.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: **Owner will engage** a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
 1. Field welds will be subject to inspection.
 2. Steel decking will be considered defective if it does not pass tests and inspections.
 3. Shear Stud Connectors: In addition to visual inspection, test and inspect field-welded shear connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:

- a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - b. Conduct tests in accordance with requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors that are already tested.
- C. Prepare test and inspection reports.

END OF SECTION 053100

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Interior non-load-bearing wall framing.
 - 2. Ceiling joist framing.

1.2 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Cold-formed steel framing materials.
 - 2. Ceiling joist framing.
 - 3. Soffit framing.
- 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.

1.3 INFORMATIONAL SUBMITTALS

- A. Shop drawings sealed by engineer registered in North Carolina.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect and store cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling as required in AISI S202.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer 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.

2.2 INTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges.
- C. Vertical Deflection Clips, Interior: Manufacturer's standard bypass or **head** clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

2.3 CEILING JOIST FRAMING

- A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, **punched with standard holes** with stiffened flanges.

2.4 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated.

2.5 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.

2.6 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 and manufacturer's written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, conditions, 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, AISI S202, and 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.
- D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

3.3 INSTALLATION OF INTERIOR NONLOADBEARING WALL FRAMING

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.
- B. Fasten both flanges of studs to **[top and]** bottom track unless otherwise indicated. Space studs as indicated on construction documents:
- 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.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicate **[on Shop Drawings]** but not more than 48 inches apart. Fasten at each stud intersection.

3.4 INSTALLATION OF JOIST FRAMING

- A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated **[on Shop Drawings]**.
- B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
 - 1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches.
 - 2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections.
- C. Space joists not more than 2 inches from abutting walls, and as follows:
 - 1. Joist Spacing: as shown on contract documents.
- D. Frame openings with built-up joist headers, consisting of joist and joist track or another combination of connected joists if indicated.

- E. Install bridging at intervals indicated **on Shop Drawings**. Fasten bridging at each joist intersection.
- F. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.
- G. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.5 INSTALLATION TOLERANCES

- A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
 - 1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.

3.6 REPAIR

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

3.7 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. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.8 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 - 2. Structural-steel door frames.
- B. Products furnished, but not installed, under this Section include the following:
 - 1. Loose steel lintels.
- C. Related Sections:
 - 1. Section 055100 "Metal Stairs."
 - 2. Section 055213 "Metal Railings."
 - 3. Section 057000 "Decorative Metal."

1.3 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.4 ACTION SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details for metal fabrications.
 - 1. Include plans, elevations, sections and details of metal fabrications and their connections. Show anchorage and accessory items.

1.5 QUALITY ASSURANCE

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

- B. Welding Qualifications: Qualify procedures and personnel according to the following:

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

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.7 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. 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.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

- 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.

2.2 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Tubing: ASTM A 500, cold-formed steel tubing.
- C. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) unless otherwise indicated.

2.3 FASTENERS

- A. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
- B. 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.
- C. Plain Washers: Round, ASME B18.22.1 (ASME B18.22M).

- D. Lock Washers: Helical, spring type, ASME B18.21.1 (ASME B18.21.2M).
- E. 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 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.

2.4 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Shop Primers: Provide primers that comply with Section 099123 Interior Painting."
- C. 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.
- 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.
- F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior applications.
- G. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa).

2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Cut, reinforce, drill, and tap metal fabrications as indicated to receive screws and similar items.
- H. 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.

2.6 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.
- C. Galvanize miscellaneous framing and supports where indicated.

2.7 STRUCTURAL-STEEL DOOR FRAMES

- A. Fabricate structural-steel door frames from steel shapes, plates and bars of size and to dimensions indicated, fully welded together, with 5/8-by-1-1/2-inch (16-by-38-mm) steel channel stops, unless otherwise indicated. Plug-weld built-up members and continuously weld exposed joints. Secure removable stops to frame with countersunk machine screws, uniformly spaced at not more than 10 inches (250 mm) o.c. Reinforce frames and drill and tap as necessary to accept finish hardware.
1. Provide with integrally welded steel strap anchors for securing door frames into adjoining concrete or masonry.
- B. Extend bottom of frames to floor elevation indicated with steel angle clips welded to frames for anchoring frame to floor with expansion shields and bolts.

2.8 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings and anchorages as needed to coordinate assembly and installation with other work.

2.9 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
- B. Galvanize and prime loose steel lintels located in exterior walls.
- C. Prime loose steel lintels located in exterior walls with zinc-rich primer.

2.10 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.
- C. Finish exposed surfaces to remove tool and die marks and stretch lines and to blend into surrounding surface.

2.11 STEEL 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 A123/A 123M for other steel and iron
 - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. 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.
- C. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."
- D. 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.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting and Placement: Perform cutting, drilling and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment and elevation; with edges and surfaces level, plumb, true and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size

limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 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.

3.3 ADJUSTING AND CLEANING

- A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099123 "Interior Painting."
- B. Galvanized Surfaces: Clean field welds, bolted connections and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055000

SECTION 055100 - METAL STAIRS

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.
2. Steel railings attached to metal stairs.
3. Steel handrails attached to walls adjacent to metal stairs.
4. Solid surface material treads and risers.

- B. Related Sections:

1. Section 055213 "Metal Railings" for railings.
2. Section 064023 "Interior Architectural Woodwork" for wood treads.
3. Section 092216 "Non-Structural Metal Framing" for metal backing for anchoring railings and for support framing at solid surface material treads and risers.
4. Section 099646 "Intumescent Painting" for additional requirements.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design metal stairs, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

- 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. (4.79 kN/sq. m).
2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to L/240 or 1/4 inch (6.4 mm), whichever is less.

- C. Structural Performance of Railings: Railings 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. (0.73 kN/m) applied in any direction.
- b. Concentrated load of 200 lbf (0.89 kN) 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 (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
 - b. Infill load and other loads need not be assumed to act concurrently.

1.4 ACTION SUBMITTALS

- A. Shop Drawings: Include plans, elevations, sections, details and attachments to other work.
- B. Samples for Verification: For the following products, in manufacturer's standard sizes:
 - 1. Stair treads, wood and solid surfacing materials.
 - 2. Guard and rail components, including infill panels.
- C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.
 - 1. Preassembled Stairs: Commercial class.
 - 2. Ornamental Stairs: Architectural class.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 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. 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.
- C. Coordinate locations of hanger rods and struts with other work so that they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Uncoated, Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, either commercial steel, Type B, or structural steel, Grade 25 (Grade 170), unless another grade is required by design loads; exposed.
- C. Uncoated, Hot-Rolled Steel Sheet: ASTM A 1011/A1011M, either commercial steel, Type B, or structural steel, Grade 30 (Grade 205), unless another grade is required by design loads.
- D. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating, either commercial steel, Type B, or structural steel, Grade 33 (Grade 230), unless another grade is required by design loads.

2.3 FASTENERS

- A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.
- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
- D. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).
- E. Lag Screws: ASME B18.2.1 (ASME B18.2.3.8M).
- F. Plain Washers: Round, ASME B18.22.1 (ASME B18.22M).
- G. Lock Washers: Helical, spring type, ASME B18.21.1 (ASME B18.21.2M).
- H. Post-Installed Anchors: Torque-controlled expansion 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, conducted by a qualified independent testing agency.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.

2.4 SOLID SURFACE MATERIAL TREADS AND RISERS

- A. Basis of Design: Solid surface material is based on Corian as manufactured by E. I. DuPont de Nemours, Inc. Subject to compliance with requirements, provide the named product or comparable product submitted and approved in accordance with Division 1 requirements.
- B. Configuration: Provide treads and risers with mitered joints at intersections.
 - 1. Material Thickness: 3/4 inch (19 mm).
 - 2. Nosings: Aluminum grit inlay.
- C. Substrate: 3/4-inch- (19-mm) thick, pressure treated plywood.
- D. Adhesive: As recommended by manufacturer.

2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Shop Primers: Provide primers that comply with Section 099123 "Interior Painting."
- C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- D. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa) unless otherwise indicated.
- E. Welded Wire Fabric: ASTM A 185/A 185M, 6 by 6 inches (152 by 152 mm), W1.4 by W1.4, unless otherwise indicated.

2.6 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, struts, 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. Cut, drill and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Weld exposed corners and seams continuously unless otherwise indicated.
 5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds: no evidence of a welded joint.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate joints that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

2.7 STEEL-FRAMED STAIRS

- A. 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 (1.7 mm).
1. Steel Sheet: Uncoated cold or hot-rolled steel sheet.
 2. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.
 3. Shape metal pans to include nosing integral with riser.
 4. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.

2.8 STAIR RAILINGS

- A. Comply with applicable requirements in Section 055213 "Metal Railings" and Section 057000 "Decorative Metal."

2.9 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal stairs after assembly.
- C. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- D. Apply shop primer to uncoated surfaces of metal stair components. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. 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. 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.
- F. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.
- G. Place and finish concrete fill for treads and platforms to comply with Section 033000 "Cast-in-Place Concrete."

3.2 INSTALLING TREADS AND RISERS

- A. Attach solid surface materials using a full spread of adhesive applied to substrate.

3.3 INSTALLING RAILINGS

- A. Comply with applicable requirements in Section 055213 "Metal Railings" and Section 057000 "Decorative Metal."

3.4 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections and abraded areas of shop paint and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
 - 2. Where attaching to floor structure, bolted connections to be painted with intumescent paint to thickness required to maintain fire resistance rating
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections and abraded areas of shop paint are specified in Section 099123 "Interior Painting."

END OF SECTION 055100

SECTION 055213 - METAL RAILINGS

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. Ferrous metal railings.
 - 2. All railings/guards to be custom fabricated, including balusters, rails, brackets and supports. All non-structural steel rail components to be finished with high performance epoxy paint system; perforated aluminum infill panels to be prefinished (powder-coated).

- B. Related Sections:

- 1. Section 055100 "Metal Stairs" for steel railings associated with metal stairs.
 - 2. Section 057000 "Decorative Metal" for perforated aluminum screens.
 - 3. Section 092216 "Non-Structural Metal Framing" for metal backing for anchoring railings.
 - 4. Section 099600 "High Performance Coatings" for painting requirements.
 - 5. Section 099646 "Intumescent Painting" for additional requirements.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
 - 1. Steel: 72 percent of minimum yield strength.
- C. Structural Performance: Railings 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. (0.73 kN/m) applied in any direction.
 - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - c. Uniform and concentrated 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 (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.4 ACTION SUBMITTALS

- A. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- B. Samples for Verification: For each type of exposed finish required.
 - 1. Sections of each distinctly different linear railing member, including handrails, top rails, posts and balusters.
 - 2. Fittings and brackets.
- C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of railing from single source from single fabricator.
- 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."

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.7 COORDINATION AND SCHEDULING

- 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 railings. 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.

- C. 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.
- D. Railings shall be installed after floor structure has been coated/protected; intumescent paint touch up after install to maintain required rating

PART 2 - PRODUCTS

2.1 FABRICATION

- A. Railings and Brackets: Fabricate from mild steel sections.

2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.3 STEEL AND IRON

- A. Plates, Shapes and Bars: ASTM A 36/A 36M.

2.4 FASTENERS

- A. General: Provide the following:
 - 1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), 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 exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
 - 2. Provide Phillips flat-head machine screws for exposed fasteners unless otherwise indicated.

2.5 MISCELLANEOUS MATERIALS

- A. Primers, Intermediate Coats and Topcoats: As specified in Section 099123 "Interior Painting" and Section 099646 "Intumescent Painting."

- B. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- C. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching and grouting compound.

2.6 FABRICATION

- A. General: Fabricate railings 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. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for 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 (1 mm) 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. Connections: Fabricate railings with either welded or nonwelded connections unless otherwise indicated.
- F. 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.
- G. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
 - 1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
- H. Form changes in direction by bending.
- I. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking or otherwise deforming exposed surfaces of components.
- J. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings and anchors to interconnect railing members to other work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
- K. Perforated-Metal Infill Panels: As specified in Section 057000 "Decorative Metal."
1. Orient perforated metal with pattern as indicated on Drawings.
- 2.7 FINISHES, GENERAL
- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
 - C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
 - D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.
 - E. When attaching to rated floor structure, exposed fasteners to be finished with intumescent paint to maintain fire resistance rating.
- 2.8 STEEL FINISHES
- A. For nongalvanized steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners and sleeves, except galvanize anchors to be embedded in exterior concrete or masonry.
 - B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."]
 - C. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
1. Shop prime uncoated railings with primers specified in Section 099123 "Interior Painting."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 - 1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 2. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (5 mm in 3 m).
- C. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.
- E. Protect intumescent paint finishes; if fire-resistant finish is compromised, notify Architect to coordinate any necessary action/repair.

3.3 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.
- B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

3.4 ATTACHING RAILINGS

- A. Attach railings to wall with wall brackets. Provide brackets with 1-1/2-inch (38-mm) clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
 - 1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
 - 2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

- B. Secure wall brackets and railing end flanges to building construction as follows:
 - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 - 2. For steel-framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.

3.5 ADJUSTING AND CLEANING

- A. Clean by washing thoroughly with clean water and soap and rinsing with clean water.
- B. Touchup Painting: Immediately after erection, clean field welds, bolted connections and abraded areas of shop paint and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

3.6 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 Final Acceptance.

END OF SECTION 055213

SECTION 057000 - DECORATIVE METAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Perforated aluminum screens and frames.
2. Steel angle framing and trim.

B. Related Requirements:

1. Section 055100 "Metal Stairs" for work connected to decorative metal.
2. Section 055213 "Metal Railings" for work connected to decorative metal.

1.2 COORDINATION

- A. Coordinate installation of anchorages for decorative metal items. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product, including finishing materials.
- B. Shop Drawings: Show fabrication and installation details for decorative metal.
1. Include plans, elevations, component details and attachment details.
 2. Indicate materials and profiles of each decorative metal member, fittings, joinery, finishes, fasteners, anchorages and accessory items.
- C. Samples for Verification: For each type of exposed finish.
1. Samples of perforated aluminum screens showing quality of workmanship and finishes.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing decorative metal similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- B. Installer Qualifications: Fabricator of products.

- C. Anodic Finisher Qualifications: A firm experienced in successfully applying anodic finishes of type indicated and employing competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.
- D. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store decorative metal in a well-ventilated area, away from uncured concrete and masonry and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with decorative metal by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 DECORATIVE METAL FABRICATORS

- A. Fabricator: 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. Alcobra.
 - 2. Metals Depot.
 - 3. McNichols.

2.2 METALS, GENERAL

- A. Metal Surfaces, General: Use materials with smooth, flat surfaces unless otherwise indicated. Use materials without seam marks, roller marks, rolled trade names, stains, discolorations or blemishes.

2.3 ALUMINUM

- A. Fabricate products from alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.
- B. Perforated Metal: Aluminum sheet, ASTM B 209 (ASTM B 209M), Alloy 6061-T6, 1 inch (25.4 mm) thick, with 3/4-inch (19.2-mm) holes in 1 inch (25.4 mm) o.c. rows.
- C. Plate and Sheet: ASTM B209 (ASTM B209M), Alloy 3003-H14.
 - 1. Holes Pattern: 0.25 inch round on staggered centers, 50-percent open area.

2.4 STEEL ANGLE FRAMING AND TRIM

- A. Steel Plates, Shapes and Bars: ASTM A 36/A 36M.

2.5 FASTENERS

- A. Fastener Materials: Unless otherwise indicated, provide stainless steel fasteners.
- B. Fasteners for Anchoring to Other Construction: Unless otherwise indicated, select fasteners of type, grade and class required to produce connections suitable for anchoring indicated items to other types of construction indicated.
- C. Provide concealed fasteners for interconnecting components and for attaching decorative metal items to other work unless otherwise indicated or exposed fasteners are unavoidable.
 - 1. Provide Phillips flat-head machine screws for exposed fasteners unless otherwise indicated.

2.6 MISCELLANEOUS MATERIALS

- A. Ferrous Metal Framing: Steel angles at perimeters and intermediate areas of perforated screens, handrails and guardrails, as indicated.
 - 1. Angle Size: 1-1/2 inches by 1-1/2 inches (38.1 mm by 38.1 mm).
- B. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
 - 1. For aluminum, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

2.7 FABRICATION, GENERAL

- A. Assemble items in the shop to greatest extent possible to minimize field splicing and assembly.
 - 1. Disassemble units only as necessary for shipping and handling limitations.
 - 2. Clearly mark units for reassembly and coordinated installation.
 - 3. Use connections that maintain structural value of joined pieces.
- B. Form decorative metal to required shapes and sizes, true to line and level with true curves and accurate angles and surfaces. Finish exposed surfaces to smooth, sharp, well-defined lines and arris.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.
- D. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

- E. Mill joints to a tight, hairline fit. Cope or miter corner joints.
- F. Provide necessary rebates, lugs and brackets to assemble units and to attach to other work. Cut, reinforce, drill and tap as needed to receive finish hardware, screws and similar items unless otherwise indicated.

2.8 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.9 STEEL FINISHES

- A. Shop prime steel items unless otherwise indicated.
 - 1. Shop prime with universal shop primer.

2.10 ALUMINUM FINISHES

- A. Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Color: White.
- B. Satin Anodized Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of decorative metal.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Provide anchorage devices and fasteners where needed to secure decorative metal to in-place construction.
- B. Perform cutting, drilling and fitting required to install decorative metal. Set products accurately in location, alignment and elevation, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items to be built into concrete, masonry, or similar construction.

- C. Fit exposed connections accurately together to form tight, hairline joints or, where indicated, uniform reveals and spaces for sealants and joint fillers. Where cutting, welding, and grinding are required for proper shop fitting and jointing of decorative metal, restore finishes to eliminate evidence of such corrective work.
- D. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

3.3 INSTALLATION OF DECORATIVE SCREENS

- A. Mount decorative screens at heights and in positions indicated.
 - 1. Secure to framing with specified fasteners.

3.4 CLEANING AND PROTECTION

- A. Unless otherwise indicated, clean metals by washing thoroughly with clean water and soap, rinsing with clean water and drying with soft cloths.
- B. Protect finishes of decorative metal from damage during construction period with temporary protective coverings approved by decorative metal fabricator. Remove protective covering at time of Final Acceptance.
- C. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 057000

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes wood blocking.

1.2 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. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.3 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS

- A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.
 - 3. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content: 19 percent.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWP A U1, Use categories as follows:
 - 1. UC1: Interior construction not in contact with ground or subject to moisture.

2. UC2: Interior construction not in contact with ground but may be subject to moisture. Include the following items:
 - a. Wood blocking and similar concealed members in contact with masonry or concrete.
 3. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
 4. After treatment, redry dimension lumber to 19 percent maximum moisture content.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

2.3 MISCELLANEOUS LUMBER

- A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
1. Blocking.
- B. 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.

2.4 FASTENERS

- A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches (38 mm) into wood substrate.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, as appropriate for the substrate.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Set work to required levels and lines, with members plumb, true to line, cut and fitted. Fit rough carpentry accurately to other construction. Locate blocking and similar supports to comply with requirements for attaching other construction.
- B. Provide blocking as indicated and as required to support facing materials, fixtures, specialty items and trim.

- C. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- D. Comply with AWP A M4 for applying field treatment to cut surfaces of preservative-treated lumber.
- E. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- F. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. Table 2304.10.1, "Fastening Schedule," in ICC's International Building Code (IBC).
- G. 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.

3.2 INSTALLATION OF WOOD BLOCKING

- 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 wood blocking to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

END OF SECTION 061000

SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plywood sheathing.

1.2 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 plywood complies 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 plywood complies with requirements. Include physical properties of treated materials.
3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency in accordance with ASTM D5516.
4. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Fire-retardant-treated plywood.

1.4 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: As tested in accordance with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 WOOD PANEL PRODUCTS

- A. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
- B. Factory mark panels to indicate compliance with applicable standard.

2.3 FIRE-RETARDANT-TREATED PLYWOOD

- A. General: Where fire-retardant-treated materials are indicated, use materials complying 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 Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested in accordance with ASTM E84, 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 (3.2 m) beyond the centerline of the burners at any time during the test.
 1. Use treatment that does not promote corrosion of metal fasteners.
 2. Interior Type A: Treated materials are to have a moisture content of 28 percent or less when tested in accordance with ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.
- C. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.
- E. Application: Treat plywood indicated on Drawings.

2.4 PLYWOOD FLOORING

- A. Plywood Flooring: Exterior, Structural I single-floor panels.
 1. Span Rating: Not less than 16.
 2. Nominal Thickness: Not less than 3/4 inch (19.1 mm).
 3. Edge Detail: Square.
 4. Surface Finish: Fully sanded face.

2.5 FASTENERS

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

- B. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- C. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
 - 1. Table 2304.10.1, "Fastening Schedule," in the ICC's International Building Code.
 - 2. NES NER-272 for power-driven fasteners.
- D. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

3.2 INSTALLATION OF WOOD STRUCTURAL PANEL

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:
 - 1. Combination Subfloor-Underlayment:
 - a. Screw to cold-formed metal framing.
 - b. Space panels 1/8 inch (3 mm) apart at edges and ends.

END OF SECTION 061600

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid wood stair treads.
2. Wood countertops.
3. Fire-retardant treated material.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood blocking required for installing interior architectural woodwork that are concealed within other construction before interior architectural woodwork installation.

1.2 COORDINATION

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

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Anchors.
2. Adhesives.
3. Shop finishing materials.
4. Abrasive nosings.

B. Wood-Preservative Treatment:

1. Include data and warranty information from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
2. Indicate type of preservative used and net amount of preservative retained.
3. Include chemical-treatment manufacturer's written instructions for finishing treated material and manufacturer's written warranty.

- C. Fire-Retardant Treatment: Include data and warranty information from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

- D. Waterborne Treatments: For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
- E. Shop Drawings:
 - 1. Include the following:
 - a. Dimensioned plans, elevations and sections.
 - b. Attachment details.
 - 2. Show large-scale details.
 - 3. Show locations and sizes of furring, blocking and hanging strips, including blocking and reinforcement concealed by construction and specified in other Sections.
 - 4. Apply AWI Quality Certification Program label to Shop Drawings.
- F. Samples for Verification: For the following:
 - 1. Lumber for Transparent Finish: Not less than 5 inches (125 mm) wide by 12 inches (300 mm) long, for each species and cut, finished on one side and one edge.

1.5 CLOSEOUT SUBMITTALS

- A. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.6 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
 - 1. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program.
 - 2. Installer Qualifications: Manufacturer of products.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the Architectural Woodwork Standards, Section 2.
- B. Do not deliver interior architectural woodwork until painting and similar finish operations that might damage woodwork have been completed in installation areas.
- C. Store woodwork in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.8 FIELD CONDITIONS

- A. Environmental Limitations without Humidity Control: Do not deliver or install interior architectural woodwork until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of the construction period.

- B. Field Measurements: Where interior architectural woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings.
 - 1. Locate concealed framing, blocking and reinforcements that support woodwork by field measurements before being concealed by construction, and indicate measurements on Shop Drawings.
- C. Established Dimensions: Where interior architectural woodwork is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL WOODWORK, GENERAL

- A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of interior architectural woodwork indicated for construction, finishes, installation and other requirements.
 - 1. Provide labels and certificates from AWI certification program indicating that woodwork and installation complies with requirements of grades specified.

2.2 INTERIOR WOOD STAIR TREADS

- A. Architectural Woodwork Standards Grade: Custom.
- B. Wood for Transparent Finish:
 - 1. Species and cut:
 - a. Treads: White oak, plain sawn.
 - 2. Wood Moisture Content: 8 to 13 percent.
- C. Finishes for Stair Parts:
 - 1. Treads: Transparent.

2.3 FIRE-RETARDANT-TREATED WOOD MATERIAL

- A. Fire-Retardant-Treated Wood Materials: Where fire-retardant-treated materials are indicated, use materials complying with requirements that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products in accordance with test method indicated by a qualified testing agency.
 - 1. Use treated materials that comply with requirements of the Architectural Woodwork Standards. Do not use materials that are warped, discolored, or otherwise defective.

2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
 3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.
- B. Fire-Retardant-Treated Lumber and Plywood: Products with a flame-spread index of 25 or less when tested in accordance with ASTM E84, 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 (3.2 m) beyond the centerline of the burners at any time during the test.
1. Kiln-dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.
 2. For items indicated to receive a stained, transparent, or natural finish, use organic resin chemical formulation.
 3. Mill lumber after treatment within limits set for wood removal that do not affect listed fire-test-response characteristics, using a woodworking shop certified by testing and inspecting agency.

2.4 WOOD COUNTERTOPS

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of wood countertops indicated for construction, finishes, installation, and other requirements.
1. Provide inspections of fabrication and installation together with labels and certificates from AWI certification program indicating that countertops comply with requirements of grades specified.
 2. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.
- B. Grade: Custom.
- C. Wood Countertops: For transparent finish. Fabricated from solid wood members glued together for uniform color and grain.
1. Wood Species: White oak, plain sawn.
 2. Thickness: As indicated on Drawings.

2.5 ABRASIVE NOSINGS

- A. Single Part Unit: Aluminum with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Fabricate units in lengths necessary to accurately fit openings or conditions.
1. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
 - a. Nystrom.
 - b. Wooster Products, Inc.
 - c. ACL Industries.

2. Provide ribbed bar abrasive. Aluminum alternating with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder.
3. Nosing Type: Inset, Square Front and Back: 1-3/8 inches (35 mm).
 - a. Attachment Method: Drilled Hole, Mechanically Fastened.
4. Finish: 6063-T5 aluminum, mill finish.
5. Abrasive Color: Black

2.6 MISCELLANEOUS MATERIALS

- A. Blocking: Softwood or hardwood lumber AND Fire-retardant-treated softwood lumber, kiln-dried to less than 15 percent moisture content.
 1. Preservative Treatment: Provide softwood lumber treated by pressure process, AWPA U1; Use Category UC3b.
 - a. Provide where in contact with concrete or masonry.
 - b. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
 - c. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
 - d. Mark lumber with treatment quality mark of an inspection agency approved by the American Lumber Standards Committee's (ALSC) Board of Review.
 2. Fire-Retardant Treatment: Complying with requirements; provide where indicated.
- B. Provide self-drilling screws for metal-framing supports, as recommended by metal-framing manufacturer.
- C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage.
 1. Provide metal expansion sleeves or expansion bolts for post-installed anchors.
 2. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- D. Installation Adhesive: Product recommended by fabricator for each substrate for secure anchorage.

2.7 FABRICATION

- A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- B. Fabricate interior architectural woodwork to dimensions, profiles, and details indicated.
 1. Ease edges to radius indicated for the following:
 - a. Edges of Solid-Wood (Lumber) Members: 1/16 inch (1.5 mm) unless otherwise indicated.
 - b. Edges of Rails and Similar Members More Than 3/4 Inch (19 mm) Thick: 1/8 inch (3 mm).
- C. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site.

1. Disassemble components only as necessary for shipment and installation.
2. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.
3. Notify Architect seven days in advance of the dates and times interior architectural woodwork fabrication will be complete.
4. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled.
 - a. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting.
 - b. Verify that parts fit as intended, and check measurements of assemblies against field measurements indicated on approved Shop Drawings before disassembling for shipment.

D. Stairs Treads:

1. Mechanically attach treads to steel supports from underside.

2.8 WOOD COUNTERTOP FABRICATION

- A. Fabricate wood countertops to dimensions, profiles and details indicated. Ease edges to radius of 1/8 inch (3 mm).
- B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 1. Notify Architect seven days in advance of the dates and times countertop fabrication will be complete.
 2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.
- C. Shop cut openings to maximum extent possible to receive appliances, plumbing fixtures, 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.
 1. Seal edges of openings in countertops with a coat of varnish.
- D. Shop Finishing: Finish wood countertops at fabrication shop as specified in this Section. Defer only final touchup, cleaning and polishing until after installation.
- E. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing wood countertops, as applicable to each unit of work.
 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of wood countertops. Apply two coats to end-grain surfaces.
- F. Transparent Finish:
 1. Grade: Premium.
 2. Finish: System: Catalyzed polyurethane.

3. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
4. Sheen: Satin.

2.9 SHOP FINISHING

- A. Finish interior architectural woodwork with transparent finish at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.
- B. Preparation for Finishing: Comply with Architectural Woodwork Standards, Section 5 for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing interior architectural woodwork, as applicable to each unit of work.
 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of interior architectural woodwork. Apply two coats to end-grain surfaces.
- C. Transparent Finish:
 1. Architectural Woodwork Standards Grade: Same as item to be finished.
 2. Finish System:
 - a. 11: Polyurethane, Catalyzed.
 3. Staining: Match Architect's sample.
 4. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
 5. Sheen: Matte or low sheen.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition interior architectural woodwork to humidity conditions in installation areas for not less than 72 hours prior to beginning of installation.
- B. Before installing interior architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming of concealed surfaces.

3.2 INSTALLATION

- A. Grade: Install interior architectural woodwork to comply with same grade as item to be installed.
- B. Assemble interior architectural woodwork and complete fabrication at Project site to the extent that it was not completed during shop fabrication.
- C. Install interior architectural woodwork level, plumb, true in line and without distortion.
 1. Shim as required with concealed shims.
 2. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).
- D. Scribe and cut interior architectural woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

- E. Preservative-Treated Wood: Where cut or drilled in field, treat cut ends and drilled holes in accordance with AWPA M4.
- F. Anchor interior architectural woodwork to anchors or blocking built in or directly attached to substrates.
 - 1. Secure with countersunk, concealed fasteners and blind nailing.
 - 2. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with interior architectural woodwork.
 - 3. For shop-finished items, use filler matching finish of items being installed.
- G. Standing and Running Trim:
 - 1. Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible.
 - 2. Do not use pieces less than 96 inches (2400 mm) long, except where shorter single-length pieces are necessary.
 - 3. Scarf running joints and stagger in adjacent and related members.
 - 4. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches (3 mm in 2400 mm).
- H. Stairs: Securely anchor treads to supporting substrates.
 - 1. Install treads no more than 1/8 inch (3 mm) from indicated position.
 - 2. Secure with countersunk, concealed fasteners.
 - 3. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with wood surface.

3.3 WOOD COUNTERTOP INSTALLATION

- A. Grade: Install wood countertops to comply with same grade as item to be installed.
- B. Assemble wood countertops and complete fabrication at Project site to the extent that it was not completed in the shop.
- C. Field Jointing: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.
 - 1. Secure field joints in countertops with concealed clamping devices located within 6 inches (150 mm) of front and back edges and at intervals not exceeding 24 inches (600 mm). Tighten in accordance with manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.
- D. Scribe and cut wood countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Countertop Installation: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
 - 1. Install countertops level and true in line. Use concealed shims as required to maintain not more than a 1/8-inch-in-96-inches (3-mm-in-2400-mm) variation from a straight, level plane.

2. Secure backsplashes to walls with adhesive.
3. Seal joints between countertop and backsplash, and joints where countertop and backsplash abut walls with sealant specified in Section 079200 "Joint Sealants."

F. Shop Finishes: Touch up finishing after installation of wood countertops.

1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.

3.4 FIELD QUALITY CONTROL

A. Inspections: Provide inspection of installed Work through AWI's Quality Certification Program certifying that woodwork, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade.

1. Inspection entity is to prepare and submit report of inspection.

3.5 REPAIR

A. Repair damaged and defective interior architectural woodwork, where possible, to eliminate functional and visual defects and to result in interior architectural woodwork being in compliance with requirements of Architectural Woodwork Standards for the specified grade.

B. Where not possible to repair, replace defective woodwork.

C. Field Finish: See Section 099123 "Interior Painting" for final finishing of installed interior architectural woodwork not indicated to be shop finished.

D. Repair damaged and defective wood countertops, where possible, to eliminate functional and visual defects. Where not possible to repair, replace countertops. Adjust joinery for uniform appearance.

3.6 CLEANING

A. Clean interior architectural woodwork on exposed and semi-exposed surfaces.

B. Clean wood countertops on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 064023

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 and shelves.
 - 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.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product, including high-pressure decorative laminate, adhesive for bonding plastic laminate and cabinet hardware and accessories.

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

- 1. Show details full size.
 - 2. Show locations and sizes of furring, blocking and hanging strips, including concealed blocking and reinforcement specified in other Sections.
 - 3. Show locations and sizes of cutouts and holes for electrical switches and outlets and other items installed in architectural plastic-laminate cabinets.
 - 4. Apply AWI Quality Certification Program label to Shop Drawings.

- C. Samples for Verification:

- 1. Plastic laminates, 8 by 10 inches (200 by 250 mm), for each type, color, pattern, and surface finish, with one sample applied to core material.
 - 2. Thermoset decorative panels, 8 by 10 inches (200 by 250 mm).
 - 3. Exposed cabinet hardware and accessories, one unit for each type and finish.

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. Shop is a certified participant in AWI's Quality Certification Program.
- B. Installer Qualifications: Fabricator of products.
- C. 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.
- D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockups of typical plastic-laminate cabinets as shown on Drawings.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. 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 and relative humidity at occupancy levels during the remainder of the construction period.
- B. 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 (16 and 32 deg C) and relative humidity between 43 and 70 percent during the remainder of the construction period.
- C. 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.
- D. 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 ARCHITECTURAL CABINET FABRICATORS

- A. Fabricators: Subject to compliance with requirements, provide products by one of the following:
 - 1. Interior Wood Specialties.
 - 2. Stephenson Millwork, Inc.
 - 3. TMI Systems Design Corp.

2.2 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural plastic-laminate cabinets indicated for construction, finishes, installation, and other requirements.
 - 1. Provide labels and certificates from AWI certification program indicating that woodwork, including installation, complies with requirements of grades specified.
- B. Grade: Custom.
- C. Type of Construction: Frameless.
- D. Cabinet, Door, and Drawer Front Interface Style: Flush overlay.
- E. 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. Formica Corporation.
 - b. Panolam Industries International, Inc.
 - c. Wilsonart International; Div. of Premark International, Inc.
- F. Laminate Cladding for Exposed Surfaces:
 - 1. Horizontal Surfaces: Grade HGS.
 - 2. Postformed Surfaces: Grade HGP.
 - 3. Vertical Surfaces: Grade HGS.
 - 4. Edges: Plastic laminate on all exposed surfaces.
 - 5. Pattern Direction: Vertically for drawer fronts, doors and fixed panels.
- G. Materials for Semi-exposed Surfaces:

1. Surfaces Other Than Drawer Bodies: Thermoset decorative panels.
 - a. Edges of Thermoset Decorative Panel Shelves: PVC or polyester edge banding.
 - b. For semiexposed 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: Solid-hardwood lumber.
 3. Drawer Bottoms: Hardwood plywood.
- H. Dust Panels: 1/4-inch (6.4-mm) plywood or tempered hardboard above compartments and drawers unless located directly under tops.
- I. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.
- J. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.
- K. Shelves: 3/4-inch- (19-mm-) thick plywood, plastic laminate on all faces.
- L. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
1. As selected by Architect from laminate manufacturer's full range in the following categories:

2.3 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.
 2. Softwood Plywood: DOC PS 1, medium-density overlay.
 3. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, made with adhesive containing no urea formaldehyde.
 4. Thermoset Decorative Panels: Medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMALD3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.4 FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials complying 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.

1. Use treated materials that comply with requirements of referenced woodworking standard. Do not use materials that are warped, discolored, or otherwise defective.
 2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
 3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.
- B. Fire-Retardant-Treated Lumber and Plywood: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, 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 (3.2 m) beyond the centerline of the burners at any time during the test.
1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.
 2. Mill lumber after treatment within limits set for wood removal that do not affect listed fire-test-response characteristics, using a woodworking shop certified by testing and inspecting agency.

2.5 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, 170 degrees of opening, self-closing.
- C. Wire Pulls: Back mounted, solid metal 4 inches (100 mm) long, 5/16 inch (8 mm) in diameter.
- D. Catches: Push-in magnetic catches, BHMAA156.9, B03131.
- E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.
- F. Shelf Rests: BHMA A156.9, B04013; metal.
- G. Drawer Slides: BHMA A156.9.
1. Grade 1 and Grade 2: Side mounted, full-extension type; zinc-plated steel with polymer rollers.
 2. For drawers not more than 3 inches (75 mm) high and not more than 24 inches (600 mm) wide, provide Grade 1.
 3. For drawers more than 3 inches (75 mm) high but not more than 6 inches (150 mm) high and not more than 24 inches (600 mm) wide, provide Grade 1.
 4. For drawers more than 6 inches (150 mm) high or more than 24 inches (600 mm) wide, provide Grade 1HD-100.
 5. For shelves, provide Grade 1HD-100.
- H. Door Locks: BHMA A156.11, E07121.
- I. Drawer Locks: BHMA A156.11, E07041.

- J. Door and Drawer Silencers: BHMA A156.16, L03011.
- K. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
 - 1. Satin Stainless Steel: BHMA 630.
- L. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.6 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: Contact cement.
 - 1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.7 FABRICATION

- A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- B. Fabricate cabinets to dimensions, profiles and details indicated.
- C. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming and fitting.
 - 1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
 - 2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.
- D. 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. Grade: Install cabinets to comply with same grade as item to be installed.
- B. Assemble cabinets and complete fabrication at Project site to the extent that it was not completed in the shop.
- C. 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 (3 mm in 2400 mm).
- D. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces and repair damaged finish at cuts.
- E. 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.
- F. 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 (3 mm in 2400-mm) 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 (400 mm) o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

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.
- C. Clean cabinets on exposed and semi-exposed surfaces.

END OF SECTION 064116

SECTION 078123 - INTUMESCENT MASTIC FIREPROOFING

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

Section includes mastic and intumescent fire-resistive coatings (MIFRC) applied to primary and secondary structural steel members and connections to provide specified fire resistance rating.

1.3 RELATED WORK OF OTHER SECTIONS

- A. Coordinate work of this section with work of other sections as required to properly execute the work and as necessary to maintain satisfactory progress of the work of other sections, including:
 - 1. Section 05 12 00 – Structural Steel Framing
 - 2. Section 05 50 00 – Metal Fabrications
 - 3. Section 09 91 23 – Interior Painting

1.4 REFERENCE STANDARDS

- 1. ASTM D2794 - Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation — Impact Resistance
- 2. ASTM D4060 - Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser — Abrasion Resistance
- 3. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers — Bond Strength
- 4. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials
- 5. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials
- 6. National Fire Protection Association, NFPA 251
- 7. Underwriters Laboratories Inc. (UL) ANSI/UL263

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review products, design ratings, restrained and unrestrained conditions, thicknesses, and other performance requirements.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Structural framing plans indicating the following:
 - 1. Extent of fireproofing for each construction and fire-resistance rating.
 - 2. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
 - 3. Minimum fireproofing thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
 - 4. Treatment of fireproofing after application.
- C. Samples:
 - 1. Submit mockup or representative sample of MIFRC finished steel in maximum thickness required to achieve required rating. Sample to demonstrate final finish

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.
- B. Field Constructed Mockups: Prior to installing intumescent coatings, Installer shall apply products specified for exposed applications to demonstrate aesthetic qualities and workmanship. Build mockups to comply with the following requirements, using materials indicated for final unit of Work.
 - 1. Location: As approved by Architect
 - 2. Extent of Mockups: Approximately 5 sq. ft. of surface
 - 3. Notify architect one week in advance of the dates and times when mockups will be built.
 - 4. Obtain architect's written acceptance of mockups before start of actual unit of work.
 - 5. Retain and maintain mockups during construction in undisturbed condition as a standard for judging completed units of work.
 - a. Accepted mockups in undisturbed condition at time of substantial completion may become part of completed unit of work.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply fireproofing when ambient or substrate temperature is 50 deg F (10 deg C) or lower unless temporary protection and heat are provided to

maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.

- B. Ventilation: Ventilate building spaces during and after application of fireproofing, providing complete air exchanges according to manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fireproofing dries thoroughly.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Assemblies: Provide fireproofing, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.
- B. Source Limitations: Obtain fireproofing from single source.
- C. Fire-Resistance Design: Indicated on Drawings, tested according to ASTM E 119 or UL 263 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- D. Asbestos: Provide products containing no detectable asbestos.

2.2 MASTIC AND INTUMESCENT FIRE-RESISTIVE COATINGS

- A. MIFRC: Manufacturer's standard factory-mixed formulation or factory-mixed, multicomponent system consisting of intumescent base coat and topcoat and complying with indicated fire-resistance design.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hilti Fire Finish CFP-SP WB by Hilti, Inc.
 - b. Carbolite Company, subsidiary of RPM International, Fireproofing Products Div.; Thermo-Lag 3000-SP and Thermo-Sorb.
 - c. Isolatek International; Cafco SprayFilm-WB 3 and Cafco SprayFilm-WB 4.
 - 2. Application: Designated for "interior general purpose" and "conditioned interior space purpose" use by a qualified testing agency acceptable to authorities having jurisdiction.
 - 3. Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design.
 - 4. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 0.
 - b. Smoke-Developed Index: 50 or less.
 - 5. Color, Finish and Gloss: As selected by Architect from manufacturer's standards.

2.3 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that are compatible with fireproofing and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.
- B. Substrate Primers: Primers approved by fireproofing manufacturer and complying with required fire-resistance design by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and according to each fire-resistance design. Verify compliance with the following:
 - 1. Substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants or other foreign substances capable of impairing bond of fireproofing with substrates under conditions of normal use or fire exposure.
 - 2. Objects penetrating fireproofing, including clips, hangers, support sleeves and similar items, are securely attached to substrates.
 - 3. Substrates receiving fireproofing are not obstructed by ducts, piping, equipment or other suspended construction that will interfere with fireproofing application.
- B. Conduct tests according to fireproofing manufacturer's written recommendations to verify that substrates are free of substances capable of interfering with bond.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Cover other work subject to damage from fallout or overspray of fireproofing materials during application.
- B. Clean substrates of substances that could impair bond of fireproofing.
- C. Prime substrates where included in fire-resistance design and where recommended in writing by fireproofing manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fireproofing.

3.3 APPLICATION

- A. Construct fireproofing assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, topcoats, finishing, and other materials and procedures affecting fireproofing work.

- B. Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.
- C. Coordinate application of fireproofing with other construction to minimize need to cut or remove fireproofing.
 - 1. Do not begin applying fireproofing until bolted connections have been pre-drilled.
 - 2. Defer installing ducts, piping and other items that would interfere with applying fireproofing until application of fireproofing is completed.
- D. Install auxiliary materials as required, as detailed, and according to fire-resistance design and fireproofing manufacturer's written recommendations for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by fireproofing manufacturer.
- E. Spray apply fireproofing to maximum extent possible. Following the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by fireproofing manufacturer.
- F. Extend fireproofing in full thickness over entire area of each substrate to be protected.
- G. Install body of fireproofing in a single course unless otherwise recommended in writing by fireproofing manufacturer.
- H. Provide a uniform finish complying with description indicated for each type of fireproofing material and matching finish approved for required mockups.
- I. Cure fireproofing according to fireproofing manufacturer's written recommendations.
- J. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, and tested and corrections have been made to deficient applications.
- K. Finishes: Where indicated, apply fireproofing to produce the following finishes:
 - 1. Manufacturer's Standard Finishes: Finish according to manufacturer's written instructions for each finish selected.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
 - 1. Test and inspect as required by the IBC, 1704.11.
- B. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fireproofing for the next area until test results for previously completed applications of fireproofing show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.
- C. Fireproofing will be considered defective if it does not pass tests and inspections.

1. Remove and replace fireproofing that does not pass tests and inspections, and retest.
2. Apply additional fireproofing, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.

D. Prepare test and inspection reports.

3.5 CLEANING, PROTECTING, AND REPAIRING

- A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.
- B. Bolted connections shall be painted after railings are installed.
- C. Protect fireproofing, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fireproofing will be without damage or deterioration at time of Substantial Completion.
- D. As installation of other construction proceeds, inspect fireproofing and repair damaged areas and fireproofing removed due to work of other trades.
- E. Repair fireproofing damaged by other work before concealing it with other construction.
- F. Repair fireproofing by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

END OF SECTION 078123

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Penetrations in fire-resistance-rated walls.
 - 2. Penetrations in horizontal assemblies.
 - 3. Penetrations in smoke barriers.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A firm experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.
- B. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:
 - 1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.
 - b. Classification markings on penetration firestopping correspond to designations listed by the following:
 - 1) UL in its "Fire Resistance Directory."

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

1.5 PROJECT CONDITIONS

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

1.6 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.
- C. Notify Owner's testing agency at least seven days in advance of penetration firestopping installations; confirm dates and times on day preceding each series of installations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Grace Construction Products.
 - 2. Hilti, Inc.
 - 3. 3M Fire Protection Products.

2.2 PENETRATION FIRESTOPPING

- A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings and with penetrating items if any.
- B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
 - 1. Fire-resistance-rated walls include fire walls, fire-barrier walls, smoke-barrier walls and fire partitions.
 - 2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

- C. Penetrations in Horizontal Assemblies: Provide penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
 - 1. F-Rating: At least one-hour, but not less than the fire-resistance rating of constructions penetrated.
 - 2. T-Rating: At least one-hour, but not less than the fire-resistance rating of constructions penetrated, except for floor penetrations within the cavity of a wall.
- D. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.
 - 1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at 0.30-inch wg (74.7 Pa) at both ambient and elevated temperatures.
- E. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.
 - 1. Permanent forming/damming/backing materials, including the following:
 - a. Slag-wool-fiber or rock-wool-fiber insulation.
 - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
 - c. Fire-rated form board.
 - d. Fillers for sealants.
 - 2. Temporary forming materials.
 - 3. Substrate primers.
 - 4. Collars.
 - 5. Steel sleeves.

2.3 MIXING

- A. For those products requiring mixing before application, comply with penetration firestopping manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions and with the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.3 INSTALLATION

- A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.
- C. Install fill materials for firestopping by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

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

3.6 CLEANING AND PROTECTION

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

END OF SECTION 078413

SECTION 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.

1.3 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
- C. Product Testing: Test joint sealants using a qualified testing agency.
 - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

1.5 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.6 WARRANTY

- A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Final Acceptance.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Final Acceptance.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 - 1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 - 2. Disintegration of joint substrates from natural causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or other outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS, 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 full range.

2.2 SILICONE JOINT SEALANTS

- A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dow Corning Corporation.
 - b. Pecora Corporation.
 - c. Tremco Incorporated.

2.3 URETHANE JOINT SEALANTS

- A. Single-Component, Non-sag, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

1. Manufacturers: Subject to compliance with requirements, provide one of the following:
 - a. BASF Building Systems.
 - b. Pecora Corporation.
 - c. Tremco Incorporated.

2.4 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Joint Sealant: Manufacturer's standard non-sag, paintable, non-staining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Pecora Corporation; AC-20 FTR.
 - b. USG Corporation; SHEETROCK Acoustical Sealant.

2.5 JOINT SEALANT BACKING

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

2.6 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Non-staining, 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 joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Non-sag 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.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 CLEANING

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

3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove 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.

1. Joint Locations:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints of exterior openings.
 - c. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
 2. Joint Sealant: Urethane based.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
1. Joint Sealant Location:
 - a. Joints between plumbing fixtures and adjoining walls, floors and counters.
 2. Joint Sealant: Mildew resistant, single component, non-sag, neutral curing, Silicone.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 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.
 - 2. Section 101473 "Painted Signage" for signage to be painted on certain 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 PREINSTALLATION MEETINGS

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

1.6 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 "Doors" and "Frames" subparagraphs below, prepare Samples approximately 12 by 12 inches (305 by 305 mm) 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.

1.7 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- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ceco Door Products; an Assa Abloy Group company.
 2. Curries Company; an Assa Abloy Group company.
 3. Republic Doors and Frames.
 4. Steelcraft; an Ingersoll-Rand company.
- 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, Borrowed-Light Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.3 INTERIOR 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. Standard-Duty Doors and Frames: SDI A250.8, Level 1.
 - 1. Physical Performance: Level C according to SDI A250.4.
 - 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches (44.5 mm).
 - c. Face: Metallic-coated, cold-rolled steel sheet, minimum thickness of 0.032 inch (0.8 mm).
 - d. Edge Construction: Model 2, Seamless.
 - 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, cold-rolled steel sheet, minimum thickness of 0.042 inch (1.0 mm).
 - b. Construction: Full profile welded.
 - 4. Exposed Finish: Prime.

2.4 HOLLOW-METAL PANELS

- A. Provide hollow-metal panels of same materials, construction, and finish as adjacent door assemblies.

2.5 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 (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (51 mm) wide by 10 inches (254 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
 3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
 4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-(9.5-mm-) 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 (1.0 mm), 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 (51-mm) height adjustment. Terminate bottom of frames at finish floor surface.

2.6 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 (12G) coating designation; mill phosphatized.
- 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. 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.
- H. Glazing: Comply with requirements in Section 088000 "Glazing."
- I. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.7 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. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch (0.66 mm), steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches (152 mm) apart. Spot weld to face sheets no more than 5 inches (127 mm) o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
 - 2. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches (3.2 mm in 51 mm).
 - 3. Top Edge Closures: Close top edges of doors with inverted 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. 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 (19 mm) 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. Sidelight Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
 - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 3. 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.
 - 4. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 16 inches (406 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c., to match coursing, and as follows:
 - 1) Two anchors per jamb up to 60 inches (1524 mm) high.
 - 2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
 - 3) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.
 - 4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 120 inches (3048 mm) high.
 - b. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches (1524 mm) high.

- 2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
 - 3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
 - 4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438 mm) high.
5. 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 nontemplated, 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.

2.8 STEEL FINISHES

- A. Prime Finish: Clean, pretreat and apply manufacturer's standard primer.
 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.9 ACCESSORIES

- A. Louvers: Provide louvers for interior doors, where indicated, which comply with SDI 111C, with blades or baffles formed of 0.020-inch- (0.5-mm-) thick, cold-rolled steel sheet set into 0.032-inch- (0.8-mm-) thick steel frame.
 1. Sightproof Louver: Stationary louvers constructed with inverted-V or inverted-Y blades.
 2. Lightproof Louver: Stationary louvers constructed with baffles to prevent light from passing from one side to the other.

- B. Mullions: Join to adjacent members by welding or rigid mechanical anchors.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. 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 nontemplated, 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 of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
 - 1. Set frames accurately in position; plumbed, aligned and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - f. Check plumb, square and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - g. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
 - 2. 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. 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 (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), 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 (3.2 mm) plus or minus 1/32 inch (0.8 mm).
 - b. Between Edges of Pairs of Doors: 1/8 inch (3.2 mm) to 1/4 inch (6.3 mm) plus or minus 1/32 inch (0.8 mm).
 - c. At Bottom of Door: 5/8 inch (15.8 mm) plus or minus 1/32 inch (0.8 mm).
 - d. Between Door Face and Stop: 1/16 inch (1.6 mm) to 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).
 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
 3. Smoke-Control Doors: Install doors and gaskets according to NFPA 105.
 - 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 (230 mm) o.c. and not more than 2 inches (51 mm) 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. 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.
 - C. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Access doors and frames.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, fire ratings, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Samples: For each type of access door and frame and for each finish specified, complete assembly minimum 6 by 6 inches (150 by 150 mm) in size.
- C. Product schedule.

PART 2 - PRODUCTS

2.1 ACCESS DOORS AND FRAMES

- A. Flush Access Doors with Concealed Flanges:
 - 1. Description: Face of door flush with frame; with concealed flange for gypsum board installation and concealed hinge.
 - 2. Locations: Wall and ceiling.
 - 3. Door Size: 48 inches by 48 inches (1219 mm by 1219 mm).
 - 4. Metallic-Coated Steel Sheet for Door: Nominal 0.064 inch (1.63 mm), 16 gage, factory primed.
 - 5. Frame Material: Same material and thickness as door.
 - 6. Latch and Lock: Self-latching door hardware, operated by key with interior release.
- B. Basis of Design: Access doors are based on Model WB RDW 410 as manufactured by Williams Brothers Corporation of America Subject to compliance with requirements, provide the named products or comparable products by one of the following:
 - 1. J.L. Industries.
 - 2. Milcor, Inc.
 - 3. Nystrom, Inc.

2.2 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

- B. Steel Sheet: Uncoated or electrolytic zinc coated 14 ga., ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.
- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- D. Frame Anchors: Same material as door face.
- E. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.3 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
 - 1. For concealed flanges with plaster bead for full-bed plaster applications, provide zinc-coated expanded-metal lath and exposed casing bead welded to perimeter of frames.
- D. Latch and Lock Hardware:
 - 1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
 - a. Screwdriver operated cam lock in low security areas.
 - b. Medeco locks shall be provided for access doors in high security areas. Contractor shall confirm high security areas with the Owner.
 - 2. Keys: Furnish two keys per lock and key all locks alike. All end user keys and factory bitting information shall be sent directly to Wake County GSA Safety and Security.

2.4 FINISHES

- A. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates 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. Comply with manufacturer's written instructions for installing access doors and frames.

3.3 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 083113

SECTION 083513 - FOLDING GLASS WALLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Panel folding glass walls.

1.2 PREINSTALLATION MEETINGS

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

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 folding doors.

B. Shop Drawings:

1. Include plans, elevations, sections, and installation details.
2. Include clearances required for operation, operating and control mechanisms and accessory items.

C. Samples for Verification: For each type of exposed finish.

1. Include Samples of hardware and accessories to verify color and finish selection.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For folding doors to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer of fire-rated folding doors.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install folding 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 levels intended for building occupants after completion of construction during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 FOLDING GLASS WALLS

- A. Description: Folding glass walls hinged together in pairs with top supported overhead tcarriage.
- B. Basis of Design: Folding doors are based on Model SL45 as manufactured by NanaWall Systems, Inc. Subject to compliance with requirements, provide the named products or comparable products by one of the following:
 - 1. CR Laurence.
 - 2. Panda Windows and Doors.
- C. Frames: Manufacturer's standard, formed from aluminum.
 - 1. Profile Thickness: A1-3/4 inches (45 mm).
 - 2. Sizes and Configuration: As indicated on Drawings.
 - 3. Sheet Metal Texture: Smooth.
 - 4. Finish: Manufacturer's standard color anodized finish.
 - a. Color: As selected by the Architect from manufacturer's full range.
- D. Glazing: Manufacturer's standard fully tempered clear glass, minimum 1/4 inch (6.4 mm) thickness.
- E. Hardware: Manufacturer's standard lever handle and trim plate.
 - 1. Locking: Multi-point at the main swing panel.
- F. Sound Transmission Coefficient: 35.
- G. Hardware: Manufacturer's standard felt pads, screws and pulls in standard finish. Hinges, pivots and manufacturer's standard wheels factory installed and as follows:
 - 1. Hinges: Manufacturer's standard.
 - 2. Overhead Carriage: Extruded aluminum.
 - 3. Sill: Surface-mounted interior sill, ADA compliant, rated for vehicular traffic.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. For folding glass walls supported by or anchored to permanent construction, advise installers of specific requirements for placement of anchorage devices. Furnish installers of other work with templates and drawings indicating locations of anchorage devices and similar items.

3.3 INSTALLATION

- A. General: Install folding glass walls complying with manufacturer's written installation instructions. Install track in one piece.

3.4 ADJUSTING

- A. Adjust units to ensure smooth, quiet operation without warping or binding. Adjust hardware to function smoothly. Confirm that latches engage accurately and securely without forcing or binding.

3.5 DEMONSTRATION

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

END OF SECTION 083513

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. Interior storefront framing.
 - 2. Interior manual-swing entrance doors and door-frame units.
- B. Related Sections:
 - 1. Section 088000 "Glazing" for glass to be installed in aluminum framing.

1.3 DEFINITIONS

- A. ADA/ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:
 - 1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
 - 2. Dimensional tolerances of building frame and other adjacent construction.
 - 3. Failure includes the following:
 - a. Deflection exceeding specified limits.
 - b. Thermal stresses transferring to building structure.
 - c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
 - d. Glazing-to-glazing contact.
 - e. Noise or vibration created by structural movements.
 - f. Loosening or weakening of fasteners, attachments and other components.
 - g. Sealant failure.
- B. Deflection of Framing Members:

1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed $L/175$ of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19 mm), whichever is less.
 2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components directly below them to less than 1/8 inch (3.2 mm) and clearance between members and operable units directly below them to less than 1/16 inch (1.5 mm).
- C. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
 2. Interior Ambient-Air Temperature: 75 deg F (24 deg C).
- D. Sound Transmission: Provide aluminum-framed systems with fixed glazing and framing areas having the following sound-transmission characteristics:
1. Typical Sound Transmission Class (STC): Minimum 35 STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.
 2. For assemblies designated as "acoustic" STC: Minimum 40 STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413. Refer to drawings.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum-framed systems.
- B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details and attachments to other work.
1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
 2. For doors, include hardware schedule and indicate operating hardware types, functions, quantities and locations.
- C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- D. Fabrication Sample: Of each vertical-to-horizontal intersection of aluminum-framed systems, made from 12-inch (300-mm) lengths of full-size components and showing details of the following:
1. Joinery, including concealed welds.
 2. Anchorage.

3. Expansion provisions.
4. Glazing.

E. Other Action Submittals:

1. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.
- C. Accessible Entrances: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines.
- D. Source Limitations for Aluminum-Framed Systems: Obtain from single source from single manufacturer.
- E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code - Aluminum."
- F. Preinstallation Conference: Conduct conference at Project site.

1.8 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration caused by thermal movements.
 - c. Deterioration of metals, metal finishes and other materials beyond normal weathering.
 - d. Adhesive or cohesive sealant failures.
 - e. Water leakage through fixed glazing and framing areas.
 - f. Failure of operating components.
 - 2. Warranty Period: 10 years from date of Final Acceptance.
- B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.
 - 1. Warranty Period: 10 years from date of Final Acceptance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. EFCO Corporation.
 - 2. Kawneer North America; an Alcoa company.
 - 3. YKK AP America Inc.

2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - 1. Sheet and Plate: ASTM B 209 (ASTM B 209M).
 - 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
 - 3. Extruded Structural Pipe and Tubes: ASTM B 429.
 - 4. Structural Profiles: ASTM B 308/B 308M.
 - 5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

2.3 FRAMING SYSTEMS

- A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Nonthermal.
 2. Glazing System: Retained mechanically with gaskets on four sides.
 3. Glazing Plane: Center.
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 2. Reinforce members as required to receive fastener threads.
 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.
- E. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.

2.4 GLAZING SYSTEMS

- A. Glazing: As specified in Section 088000 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.
- D. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

2.5 DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
1. Door Construction: 1-3/4-inch (44.5-mm) overall thickness, with minimum 0.125-inch- (3.2-mm-) 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.
 2. Door Design: As indicated.
 - a. Accessible Doors: Smooth surfaced for width of door in area within 10 inches (255 mm) above floor or ground plane.
 3. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.
 4. Acoustic storefront entry doors, minimum STC 39 and acoustic seals.

- B. Door Hardware: As specified in Section 087100 "Door Hardware."

2.6 ACCESSORY MATERIALS

- A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Section 079200 "Joint Sealants."
- B. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil (0.762-mm) thickness per coat.

2.7 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
 - 4. Physical and thermal isolation of glazing from framing members.
 - 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 6. 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. Storefront Framing: Fabricate components for assembly using shear-block system or screw-spline system.
- F. Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
 - 1. 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.
- G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.8 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

- A. General:
 - 1. Comply with manufacturer's written instructions.
 - 2. Do not install damaged components.
 - 3. Fit joints to produce hairline joints free of burrs and distortion.
 - 4. Rigidly secure nonmovement joints.
 - 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
 - 6. Seal joints watertight unless otherwise indicated.
- B. Metal Protection:
 - 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
 - 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
- D. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 "Joint Sealants" to produce weathertight installation.
- E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.
- F. Install glazing as specified in Section 088000 "Glazing."
- G. Doors: Install doors to produce smooth operation and tight fit at contact points.
- H. Install perimeter joint sealants as specified in Section 079200 "Joint Sealants" to produce weathertight and/or acoustically sealed installation.

3.3 ERECTION TOLERANCES

- A. Install aluminum-framed systems to comply with the following maximum erection tolerances:
 - 1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/4 inch (6 mm) over total length.
 - 2. Alignment:

- a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch (1.5 mm).
 - b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch (0.8 mm).
- B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch (3 mm).

3.4 ADJUSTING

- A. Adjust operating door hardware to function smoothly as recommended by manufacturer.
 - 1. For doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches (75 mm) from the latch, measured to the leading door edge.

END OF SECTION 084113

SECTION 08 71 00 – DOOR HARDWARE

GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes:

- 1. Mechanical and electrified door hardware for:
 - a. Swinging doors.
 - b. Sliding doors.
- 2. Electronic access control system components, including:
 - a. Electronic access control devices.

- B. Exclusions: Unless specifically listed in hardware sets, hardware is not specified in this section for:

- 1. Windows
- 2. Cabinets (casework), including locks in cabinets
- 3. Signage
- 4. Toilet accessories
- 5. Overhead doors

- C. Related Sections:

- 1. Division 01 Section "Alternates" for alternates affecting this section.
- 2. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
- 3. Division 09 sections for touchup finishing or refinishing of existing openings modified by this section.
- 4. Division 13 Section "Radiation Protection" for requirements for lead-lining for door hardware at openings indicated to receive radiation protection.
- 5. Division 26 sections for connections to electrical power system and for low-voltage wiring.
- 6. Division 28 sections for coordination with other components of electronic access control system.

1.03 REFERENCES

- A. UL - Underwriters Laboratories

- 1. UL 10B - Fire Test of Door Assemblies
- 2. UL 10C - Positive Pressure Test of Fire Door Assemblies

3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware
- B. DHI - Door and Hardware Institute
 1. Sequence and Format for the Hardware Schedule
 2. Recommended Locations for Builders Hardware
 3. Key Systems and Nomenclature
- C. ANSI - American National Standards Institute
 1. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties

1.04 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 requirements.
2. Highlight, encircle, or otherwise specifically identify on submittals deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

B. Action Submittals:

1. Product Data: Product data including manufacturers' technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
 - a. Wiring Diagrams: For power, signal, and control wiring and including:
 - 1) Details of interface of electrified door hardware and building safety and security systems.
 - 2) Schematic diagram of systems that interface with electrified door hardware.
 - 3) Point-to-point wiring.
 - 4) Risers.
3. Samples for Verification: If requested by Architect, submit production sample or sample installations of each type of exposed hardware unit in finish indicated, and tagged with full description for coordination with schedule.
 - a. Samples will be returned to supplier in like-new condition. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.
4. Door Hardware Schedule: Submit schedule with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Indicate complete designations of each item required for each door or opening, include:
 - a. Door Index; include door number, heading number, and Architects hardware set number.
 - b. Opening Lock Function Spreadsheet: List locking device and function for each opening.
 - c. Type, style, function, size, and finish of each hardware item.

- d. Name and manufacturer of each item.
- e. Fastenings and other pertinent information.
- f. Location of each hardware set cross-referenced to indications on Drawings.
- g. Explanation of all abbreviations, symbols, and codes contained in schedule.
- h. Mounting locations for hardware.
- i. Door and frame sizes and materials.
- j. Name and phone number for local manufacturer's representative for each product.
- k. Operational Description of openings with any electrified hardware (locks, exits, electromagnetic locks, electric strikes, automatic operators, door position switches, magnetic holders or closer/holder units, and access control components).
Operational description should include how door will operate on egress, ingress, and fire and smoke alarm connection.
- 1) Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work that is critical in Project construction schedule.

5. Key Schedule:

- a. All keying shall be provided by NCSU Lockshop

6. Templates: After final approval of hardware schedule, provide templates for doors, frames and other work specified to be factory prepared for door hardware installation.

C. Informational Submittals:

1. Qualification Data: For Supplier, Installer and Architectural Hardware Consultant.
2. Product Certificates for electrified door hardware, signed by manufacturer:
 - a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
3. Certificates of Compliance:
 - a. Certificates of compliance for fire-rated hardware and installation instructions if requested by Architect or Authority Having Jurisdiction.
 - b. Installer Training Meeting Certification: Letter of compliance, signed by Contractor, attesting to completion of installer training meeting specified in "QUALITY ASSURANCE" article, herein.
 - c. Electrified Hardware Coordination Conference Certification: Letter of compliance, signed by Contractor, attesting to completion of electrified hardware coordination conference, specified in "QUALITY ASSURANCE" article, herein.
4. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by qualified testing agency, for door hardware on doors located in accessible routes.
5. Warranty: Special warranty specified in this Section.

D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:
 - a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
 - b. Catalog pages for each product.
 - c. Name, address, and phone number of local representative for each manufacturer.

- d. Parts list for each product.
- e. Final approved hardware schedule, edited to reflect conditions as installed.
- f. Final keying schedule
- g. Copies of floor plans with keying nomenclature
- h. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.
- i. Copy of warranties including appropriate reference numbers for manufacturers to identify project.

1.05 QUALITY ASSURANCE

- A. Product Substitutions: Comply with product requirements stated in Division 01 and as specified herein.
 - 1. Where products indicate “acceptable manufacturers” or “acceptable manufacturers and products”, provide product from specified manufacturers, subject to compliance with specified requirements and “Single Source Responsibility” requirements stated herein.
- B. Supplier Qualifications and Responsibilities: Recognized architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that provides certified Architectural Hardware Consultant (AHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
 - 1. Warehousing Facilities: In Project's vicinity.
 - 2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
 - 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
 - 4. Coordination Responsibility: Coordinate installation of electronic security hardware with Architect and electrical engineers and provide installation and technical data to Architect and other related subcontractors.
 - a. Upon completion of electronic security hardware installation, inspect and verify that all components are working properly.
- C. Installer Qualifications: Qualified tradesmen, skilled in application of commercial grade hardware with record of successful in-service performance for installing door hardware similar in quantity, type, and quality to that indicated for this Project.
- D. Architectural Hardware Consultant Qualifications: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
 - 1. For door hardware, DHI-certified, Architectural Hardware Consultant (AHC).
 - 2. Can provide installation and technical data to Architect and other related subcontractors.
 - 3. Can inspect and verify components are in working order upon completion of installation.
 - 4. Capable of producing wiring diagrams.
 - 5. Capable of coordinating installation of electrified hardware with Architect and electrical engineers.
- E. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.
 - 1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated.

2. Manufacturers that perform electrical modifications and that are listed by testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.
- F. Fire-Rated Door Openings: Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and are identical to products tested by Underwriters Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.
- G. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
 1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.
- H. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.
- I. Keying Conference:
 1. Owner to conduct keying conference inviting required attendees as needed.
- J. Pre-installation Conference: Conduct conference at Project site.
 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 2. Inspect and discuss preparatory work performed by other trades.
 3. Inspect and discuss electrical roughing-in for electrified door hardware.
 4. Review sequence of operation for each type of electrified door hardware.
 5. Review required testing, inspecting, and certifying procedures.
- K. Coordination Conferences:
 1. Installation Coordination Conference: Prior to hardware installation, schedule and hold meeting to review questions or concerns related to proper installation and adjustment of door hardware.
 - a. Attendees: Door hardware supplier, door hardware installer, Contractor.
 - b. After meeting, provide letter of compliance to Architect, indicating when meeting was held and who was in attendance.
 2. Electrified Hardware Coordination Conference: Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.
 - a. Attendees: electrified door hardware supplier, doors and frames supplier, electrified door hardware installer, electrical subcontractor, Owner, Architect and Contractor.
 - b. After meeting, provide letter of compliance to Architect, indicating when coordination conference was held and who was in attendance.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
 - 1. Deliver each article of hardware in manufacturer's original packaging.
- C. Project Conditions:
 - 1. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
 - 2. Provide secure lock-up for door hardware delivered to Project, but not yet installed. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
- D. Protection and Damage:
 - 1. Promptly replace products damaged during shipping.
 - 2. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work.
 - 3. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.
- E. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.
- F. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.07 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.
- E. Direct shipments not permitted, unless approved by Contractor.

1.08 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Years from date of Final Acceptance, for durations indicated.
 - a. Closers:
 - 1) Mechanical: 30 years.
 - b. Exit Devices:
 - 1) Mechanical: 3 years.
 - 2) Electrified: 1 year.
 - c. Locksets:
 - 1) Mechanical: 10 years.
 - 2) Electrified: 1 year.
 - d. Continuous Hinges: Lifetime warranty.
 - e. Key Blanks: Lifetime
 - 2. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.

1.09 MAINTENANCE

- A. Extra Materials:
 - 1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents in quantities as determined by Owner.
- B. Maintenance Tools:
 - 1. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

PRODUCTS

2.01 MANUFACTURERS

- A. Approval of manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category shall be in accordance with QUALITY ASSURANCE article, herein.
- B. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.
- C. Hand of Door: Drawings show direction of slide, swing, or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.

- D. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.02 MATERIALS

A. Fasteners

1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.
 2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
 3. Provide concealed fasteners for hardware units exposed when door is closed except when no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless thru-bolts are required to fasten hardware securely. Review door specification and advise Architect if thru-bolts are required.
 4. Install hardware with fasteners provided by hardware manufacturer.
- B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.
1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

2.03 HINGES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Ives 5BB series
2. Acceptable Manufacturers and Products: Hager BB series, Stanley FBB Series

B. Requirements:

1. Provide five-knuckle ball bearing hinges conforming to ANSI/BHMA A156.1.
2. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
 - a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
 - b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
3. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
 - a. Exterior: Heavy weight, stainless steel, 4-1/2 inches (114 mm) high
 - b. Interior: Heavy weight, steel, 4-1/2 inches (114 mm) high
4. 2 inches or thicker doors:
 - a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
5. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
6. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:

- a. Steel Hinges: Steel pins
 - b. Non-Ferrous Hinges: Stainless steel pins
 - c. Out-Swinging Exterior Doors: Non-removable pins
 - d. Out-Swinging Interior Lockable Doors: Non-removable pins
 - e. Interior Non-lockable Doors: Non-rising pins
7. Width of hinges: 4-1/2 inches (114 mm) at 1-3/4 inch (44 mm) thick doors, and 5 inches (127 mm) at 2 inches (51 mm) or thicker doors. Adjust hinge width as required for door, frame, and wall conditions to allow proper degree of opening.

2.04 MORTISE LOCKS

A. Manufacturers and Products:

1. Owner Preferred Manufacturer and Product: Best 45H Series, Schlage L9000 series
2. Acceptable Manufacturers and Products: Dorma ML 9000 series

B. Requirements:

1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1 Operational, Grade 1 Security, and manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to "KEYING" article, herein.
2. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1 inch (25 mm) throw, constructed of stainless steel.
3. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
4. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide a request to exit (RX) switch that is actuated with rotation of inside lever.
5. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.
 - a. Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.

2.05 CYLINDERS

A. Manufacturers:

1. Owner Preferred Manufacturer: Best

B. Requirements:

1. Provide small format interchangeable core (SFIC) cylinders/cores zero bitted with uncut key blanks to match Owner's existing Schlage key system, compliant with ANSI/BHMA A156.5; latest revision, Section 12, Grade 1; permanent cylinders; cylinder face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein.
2. Replaceable Construction Cores.

- a. Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
 - 1) 3 construction control keys
 - 2) 12 construction change (day) keys.
- b. Provide and install construction cores for electronic wireless locks supplied by Security Contractor.
- c. Provide permanent cores, zero bitted, to Owner as directed.
- d. Owner will replace temporary construction cores with permanent cores.

2.06 KEYING

A. Keying to be performed by Owner.

1. Provide Uncut keys with the following features:
 - a. Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
 - b. Patent Protection: Keys and blanks protected by one or more utility patent(s) the year, 2029.
2. Quantity: Furnish in the following quantities.
 - a. 3 per cylinder/core.

2.07 DOOR CLOSERS

A. Manufacturers and Products:

1. Owner Preferred Manufacturer and Product: LCN 4010/4110 series
2. Acceptable Manufacturers and Products: Sargent 281/281P10 series factory assembled (without PRV), Norton 9500/PR9500 series (without PRV).

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2 inch (38 mm) diameter, with 5/8 inch (16 mm) diameter double heat-treated pinion journal.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves with separate adjustment for latch speed, general speed, and backcheck.
7. Provide closers with a solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI/BHMA Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).

10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.08 EXIT DEVICES

A. Manufacturers and Products:

1. Owner Preferred Manufacturer and Product: Von Duprin 98 series
2. Acceptable Manufacturers and Products: Detex Advantex 10 series, Precision Apex series.

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1, and UL listed for Panic Exit or Fire Exit Hardware. Cylinders: Refer to "KEYING" article, herein.
2. Provide touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
3. Touchpad: Extend minimum of one half of door width. Match exit device finish, stainless steel for US26, US26D, US28, US32, and US32D finishes; and for all other finishes, provide compatible finish to exit device. No plastic inserts are allowed in touchpads.
4. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
5. Provide flush end caps for exit devices.
6. Provide exit devices with manufacturer's approved strikes.
7. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
8. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
9. Provide cylinder dogging at non-fire-rated exit devices.
10. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
11. Where lever handles are specified as outside trim for exit devices, provide heavy-duty lever trims with forged or cast escutcheon plates. Provide vandal-resistant levers that will travel to 90-degree down position when more than 35 pounds of torque are applied, and which can easily be re-set.
 - a. Lever Style: Match lever style of locksets
12. Provide UL labeled fire exit hardware for fire rated openings.
13. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
14. Provide electrified options as scheduled.
15. Provide devices with all control inputs – door position input, external inhibit input, fire alarm input; auxiliary locking; nuisance alarm and internal horn; and, remote signaling output self-contained in the device assembly.

2.09 DOOR TRIM

A. Manufacturers:

1. Scheduled Manufacturer: Ives

2. Acceptable Manufacturers: Burns, Rockwood

B. Requirements:

1. Provide push plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick and beveled 4 edges. Where width of door stile prevents use of 4 inches (102 mm) wide plate, adjust width to fit.
2. Provide push bars of solid bar stock, diameter and length as scheduled. Provide push bars of sufficient length to span from center to center of each stile. Where required, mount back to back with pull.
3. Provide offset pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
4. Provide flush pulls as scheduled. Where required, provide back-to-back mounted model.
5. Provide pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
6. Provide pull plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick, beveled 4 edges, and prepped for pull. Where width of door stile prevents use of 4 inches (102 mm) wide plate, adjust width to fit.
7. Provide wire pulls of solid bar stock, diameter and length as scheduled.
8. Provide decorative pulls as scheduled. Where required, mount back to back with pull.

2.10 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Burns, Rockwood

B. Requirements:

1. Provide kick plates, mop plates, and armor plates minimum of 0.050 inch (1 mm) thick, beveled four edges, with countersunk screw holes as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes of plates:
 - a. Kick Plates: 10 inches (254 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs
 - b. Mop Plates: 4 inches (102 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs
 - c. Armor Plates: 36 inches (914 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs

2.11 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers: Glynn-Johnson
2. Acceptable Manufacturers: Rixson, Sargent

B. Requirements:

1. Provide heavy duty concealed mounted overhead stop or holder as specified for exterior and interior vestibule single acting doors.

2. Provide heavy duty concealed mounted overhead stop or holder as specified for double acting doors.
3. Provide heavy or medium duty and concealed or surface mounted overhead stop or holder for interior doors as specified. Provide medium duty surface mounted overhead stop for interior doors and at any door that swings more than 140 degrees before striking wall, open against equipment, casework, sidelights, and where conditions do not allow wall stop or floor stop presents tripping hazard.
4. Where overhead holders are specified provide friction type at doors without closer and positive type at doors with closer.

2.12 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Burns, Rockwood

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide convex type where mortise type locks are used and concave type where cylindrical type locks are used.
2. Where a wall stop cannot be used, provide universal floor stops for low or high rise options.
3. Where wall or floor stop cannot be used, provide medium duty surface mounted overhead stop.

2.13 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

1. Scheduled Manufacturer: Zero International
2. Acceptable Manufacturers: National Guard, Reese

B. Requirements:

1. Provide thresholds, weather-stripping (including door sweeps, seals, and astragals) and gasketing systems (including smoke, sound, and light) as specified and per architectural details. Match finish of other items.
2. Size of thresholds:
 - a. Saddle Thresholds: 1/2 inch (13 mm) high by jamb width by door width
 - b. Bumper Seal Thresholds: 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width
3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.

2.14 SILENCERS

A. Manufacturers:

1. Scheduled Manufacturer: Ives

2. Acceptable Manufacturers: Burns, Rockwood

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.15 FINISHES

A. Finish: BHMA 626/652 (US26D); except:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Continuous Hinges: BHMA 628 (US28)
3. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
4. Protection Plates: BHMA 630 (US32D)
5. Overhead Stops and Holders: BHMA 630 (US32D)
6. Door Closers: Powder Coat to Match
7. Wall Stops: BHMA 630 (US32D)
8. Latch Protectors: BHMA 630 (US32D)
9. Weatherstripping: Clear Anodized Aluminum
10. Thresholds: Mill Finish Aluminum

EXECUTION

3.01 EXAMINATION

- A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Existing Door and Frame Compatibility: Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.
- C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Where on-site modification of doors and frames is required:
 1. Carefully remove existing door hardware and components being reused. Clean, protect, tag, and store in accordance with storage and handling requirements specified herein.
 2. Field modify and prepare existing door and frame for new hardware being installed.
 3. When modifications are exposed to view, use concealed fasteners, when possible.
 4. Prepare hardware locations and reinstall in accordance with installation requirements for new door hardware and with:

- a. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
- b. Wood Doors: DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
- c. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.

3.03 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.
 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 2. Custom Steel Doors and Frames: HMMA 831.
 3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
- D. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
- E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- F. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- G. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- H. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 1. Provide construction cores for any lock provided by security provider.
 2. Furnish permanent cores to Owner for installation.
- I. Wiring: Coordinate with Division 26, ELECTRICAL sections for:
 1. Conduit, junction boxes and wire pulls.
 2. Connections to and from power supplies to electrified hardware.
 3. Connections to fire/smoke alarm system and smoke evacuation system.
 4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
 5. Testing and labeling wires with Architect's opening number.
- J. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Closers shall not be visible in corridors, lobbies and other public spaces unless approved by Architect.

- K. Closer/Holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.
- L. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed on door and system headend details.
 - 1. Configuration: Provide least number of power supplies required to adequately serve doors with electrified door hardware.
- M. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
- N. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.
- O. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- P. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- Q. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.04 FIELD QUALITY CONTROL

- A. Architectural Hardware Consultant: Engage qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
 - 1. Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.
 - 2. Owner will inspect door hardware and provide final punch list prior to Building Occupancy inspection.

3.05 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
 - 2. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately three months after date of Final Acceptance, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.06 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Final Acceptance.

3.07 DEMONSTRATION

- A. Provide training for Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Division 01 Section "Demonstration and Training."

3.08 DOOR HARDWARE SCHEDULE

- A. Locksets, exit devices, and other hardware items are referenced in the following hardware sets for series, type and function. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.
- B. Hardware Sets:

Hardware Group No. 01

Provide each FLD door(s) with the following:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
HARDWARE BY DOOR SYSTEM.				

Hardware Group No. 02

Provide each SGL door(s) with the following:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652 IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW8	652 IVE
1	EA	EU MORTISE LOCK	L9092LEU 17A RX DPS CON	626 SCH
		12/24 VDC		
1	EA	MORTISE CYLINDER	1E74	626 BES
1	EA	SURFACE CLOSER	4111 SCUSH	689 LCN
3	EA	SILENCER	SR64	GRY IVE
1	EA	CREDENTIAL READER	FURNISHED AND INSTALLED BY	
		ACCESS CONTROL PROVIDER		
1	EA	DIAGRAM	ELEVATION	DLR
1	EA	DIAGRAM	POINT TO POINT	DLR

COORDINATE WITH ELECTRICAL AND SECURITY. ENTRY BY CREDENTIAL OR KEY OVERRIDE. PRESENTING VALID CREDENTIAL TO CARD READER LOCK WILL MOMENTARILY UNLOCK LOCK AND ALLOW ENTRY.

UPON LOSS OF POWER DOOR IS LOCKED. DOOR IS ALWAYS AVAILABLE FOR FREE EGRESS. DOOR CONTACT TIED TO ACCESS CONTROL SYSTEM FOR MONITORING.

Hardware Group No. 03

Provide each PR door(s) with the following:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
8	EA	HINGE	5BB1 4.5 X 4.5 NRP	652 IVE
1	EA	MANUAL FLUSH BOLT	FB458	626 IVE
1	EA	DUST PROOF STRIKE	DP2	626 IVE
1	EA	CLASSROOM LOCK	45H-7-R-14H	626 BES
1	EA	PERMANENT CORE	AS REQUIRED	626 BES
2	EA	OH STOP	100S	630 GLY
1	EA	SURFACE CLOSER	4011	689 LCN
1	EA	MEETING STILE	328AA-S	AA ZER
1	SET	GASKETING	770AA-S	AA ZER
2	EA	DOOR BOTTOM	369AA	AA ZER

Hardware Group No. 04

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	45H-7-R-14H	626	BES
1	EA	PERMANENT CORE	AS REQUIRED	626	BES
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	SET	GASKETING	770AA-S	AA	ZER
1	EA	DOOR BOTTOM	369AA	AA	ZER

Hardware Group No. 05

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	OFFICE LOCK	45H-7-A-14H	626	BES
1	EA	PERMANENT CORE	AS REQUIRED	626	BES
1	EA	OH STOP	100S	630	GLY
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 06

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
2	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW8	✓ 652	IVE
1	EA	REMOVABLE MULLION	KR4954	689	VON
1	EA	ELEC PANIC HARDWARE	RX-98-EO	✓ 626	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-98-NL-OP-110MD 24 VDC	✓ 626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	MORTISE CYLINDER	1E74	626	BES
2	EA	PERMANENT CORE	AS REQUIRED	626	BES
2	EA	OFFSET LONG DOOR PULL	9264F 36"	630-316	IVE
2	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	EA	CREDENTIAL READER	FURNISHED AND INSTALLED BY ACCESS CONTROL PROVIDER	✓	
2	EA	DOOR CONTACT	FURNISHED AND INSTALLED BY ACCESS CONTROL PROVIDER	✓	
1	EA	DIAGRAM	ELEVATION		DLR
1	EA	DIAGRAM	POINT TO POINT		DLR

COORDINATE WITH ELECTRICAL AND SECURITY. ENTRY BY CREDENTIAL OR KEY OVERRIDE. PRESENTING VALID CREDENTIAL TO CARD READER LOCK WILL MOMENTARILY UNLOCK LOCK AND ALLOW ENTRY.

UPON LOSS OF POWER DOOR IS LOCKED. DOOR IS ALWAYS AVAILABLE FOR FREE EGRESS. DOOR CONTACT/RX TIED TO ACCESS CONTROL SYSTEM FOR MONITORING.

Hardware Group No. 07

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	PUSH BAR	9100HD-O	630	IVE
1	EA	OFFSET LONG DOOR PULL	9264F 36"	630- 316	IVE
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN

Hardware Group No. 08

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR

BY ACCESS DOOR SYSTEM.

Hardware Group No. 09

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW8	✓ 652	IVE
1	EA	EU MORTISE LOCK	L9092LEU 17A RX DPS CON 12/24 VDC	✓ 626	SCH
1	EA	PERMANENT CORE	AS REQUIRED	626	BES
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	SET	GASKETING	770AA-S	AA	ZER
1	EA	DOOR BOTTOM	369AA	AA	ZER
1	EA	CREDENTIAL READER	FURNISHED AND INSTALLED BY ACCESS CONTROL PROVIDER	✓	
1	EA	DIAGRAM	ELEVATION		DLR
1	EA	DIAGRAM	POINT TO POINT		DLR

COORDINATE WITH ELECTRICAL AND SECURITY. ENTRY BY CREDENTIAL OR KEY OVERRIDE.
PRESENTING VALID CREDENTIAL TO CARD READER LOCK WILL MOMENTARILY UNLOCK LOCK
AND ALLOW ENTRY.

UPON LOSS OF POWER DOOR IS LOCKED. DOOR IS ALWAYS AVAILABLE FOR FREE EGRESS.
DOOR CONTACT/RX TIED TO ACCESS CONTROL SYSTEM FOR MONITORING.

Hardware Group No. 10

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW8	✓ 652	IVE
1	EA	EU MORTISE LOCK	L9092LEU 17A RX DPS CON 12/24 VDC	✓ 626	SCH
1	EA	PERMANENT CORE	AS REQUIRED	626	BES
1	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	CREDENTIAL READER	FURNISHED AND INSTALLED BY ACCESS CONTROL PROVIDER	✓	
1	EA	DIAGRAM	ELEVATION		DLR
1	EA	DIAGRAM	POINT TO POINT		DLR

COORDINATE WITH ELECTRICAL AND SECURITY. ENTRY BY CREDENTIAL OR KEY OVERRIDE.
PRESENTING VALID CREDENTIAL TO CARD READER LOCK WILL MOMENTARILY UNLOCK LOCK
AND ALLOW ENTRY.

UPON LOSS OF POWER DOOR IS LOCKED. DOOR IS ALWAYS AVAILABLE FOR FREE EGRESS.
DOOR CONTACT/RX TIED TO ACCESS CONTROL SYSTEM FOR MONITORING.

Hardware Group No. 11

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
5	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW8	✓ 652	IVE
1	EA	CONST LATCHING BOLT	FB61T	630	IVE
1	EA	EU MORTISE LOCK	L9092LEU 17A RX DPS CON 12/24 VDC	✓ 626	SCH
1	EA	PERMANENT CORE	AS REQUIRED	626	BES
1	EA	OH STOP	90S (INSTALL ON INACTIVE LEAF)	630	GLY
1	EA	SURFACE CLOSER	4011	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
2	EA	SILENCER	SR64	GRY	IVE
1	EA	CREDENTIAL READER	FURNISHED AND INSTALLED BY ACCESS CONTROL PROVIDER	✓	
1	EA	DIAGRAM	ELEVATION		DLR
1	EA	DIAGRAM	POINT TO POINT		DLR

COORDINATE WITH ELECTRICAL AND SECURITY. ENTRY BY CREDENTIAL OR KEY OVERRIDE.
PRESENTING VALID CREDENTIAL TO CARD READER LOCK WILL MOMENTARILY UNLOCK LOCK
AND ALLOW ENTRY.

UPON LOSS OF POWER DOOR IS LOCKED. DOOR IS ALWAYS AVAILABLE FOR FREE EGRESS.
DOOR CONTACT/RX TIED TO ACCESS CONTROL SYSTEM FOR MONITORING.

Hardware Group No. 12

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	CLASSROOM LOCK	45H-7-R-14H	626	BES
1	EA	PERMANENT CORE	AS REQUIRED	626	BES
1	EA	OH STOP	90S	630	GLY
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 13

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5 NRP	630	IVE
2	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW8	✎ 630	IVE
1	EA	REMOVABLE MULLION	KR4954	689	VON
1	EA	ELEC PANIC HARDWARE	LX-RX-98-EO	✎ 626	VON
1	EA	ELEC PANIC HARDWARE	LX-RX-QEL-98-NL 24 VDC	✎ 626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	MORTISE CYLINDER	1E74	626	BES
2	EA	PERMANENT CORE	AS REQUIRED	626	BES
2	EA	SURFACE CLOSER	4111 SCUSH (INSTALL ON ACTIVE LEAF)	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	EA	GASKETING	488SBK PSA	BK	ZER
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A-223	A	ZER
1	EA	CREDENTIAL READER	FURNISHED AND INSTALLED BY ACCESS CONTROL PROVIDER	✎	
2	EA	DOOR CONTACT	FURNISHED AND INSTALLED BY ACCESS CONTROL PROVIDER	✎	
1	EA	DIAGRAM	ELEVATION		DLR
1	EA	DIAGRAM	POINT TO POINT		DLR

COORDINATE WITH ELECTRICAL AND SECURITY. ENTRY BY CREDENTIAL OR KEY OVERRIDE. PRESENTING VALID CREDENTIAL TO CARD READER LOCK WILL MOMENTARILY UNLOCK LOCK AND ALLOW ENTRY.

UPON LOSS OF POWER DOOR IS LOCKED. DOOR IS ALWAYS AVAILABLE FOR FREE EGRESS. DOOR CONTACT/RX TIED TO ACCESS CONTROL SYSTEM FOR MONITORING.

Hardware Group No. 14

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	45H-7-R-14H	626	BES
1	EA	PERMANENT CORE	AS REQUIRED	626	BES
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 15

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	WIRELESS LOCK	LEMS-GRWBDC-17-A BATTERY OPERATED (FURNISHED AND INSTALLED BY ACCESS CONTROL PROVIDER)	626	SCE
1	EA	PERMANENT CORE	AS REQUIRED	626	BES
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
3	EA	SILENCER	SR64	GRY	IVE

COORDINATE WITH ELECTRICAL AND SECURITY. ENTRY BY CREDENTIAL OR KEY OVERRIDE.
PRESENTING VALID CREDENTIAL TO CARD READER LOCK WILL MOMENTARILY UNLOCK LOCK
AND ALLOW ENTRY.

UPON LOSS OF POWER DOOR IS LOCKED. DOOR IS ALWAYS AVAILABLE FOR FREE EGRESS.
DOOR CONTACT TIED TO ACCESS CONTROL SYSTEM FOR MONITORING.

Hardware Group No. 16

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	PANIC HARDWARE	98-L-NL-17	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	PERMANENT CORE	AS REQUIRED	626	BES
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 17

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	CLASSROOM LOCK	45H-7-R-14H	626	BES
1	EA	PERMANENT CORE	AS REQUIRED	626	BES
1	EA	OH STOP	90S	630	GLY

Hardware Group No. 18

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW8	✈ 652	IVE
1	EA	EU MORTISE LOCK	L9092LEU 17A RX DPS CON 12/24 VDC	✈ 626	SCH
1	EA	PERMANENT CORE	AS REQUIRED	626	BES
1	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	CREDENTIAL READER	FURNISHED AND INSTALLED BY ACCESS CONTROL PROVIDER	✈	
1	EA	DIAGRAM	ELEVATION		DLR
1	EA	DIAGRAM	POINT TO POINT		DLR

COORDINATE WITH ELECTRICAL AND SECURITY. ENTRY BY CREDENTIAL OR KEY OVERRIDE.
PRESENTING VALID CREDENTIAL TO CARD READER LOCK WILL MOMENTARILY UNLOCK LOCK
AND ALLOW ENTRY.

UPON LOSS OF POWER DOOR IS LOCKED. DOOR IS ALWAYS AVAILABLE FOR FREE EGRESS.
DOOR CONTACT/RX TIED TO ACCESS CONTROL SYSTEM FOR MONITORING.

Hardware Group No. 19

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW8	✓ 652	IVE
1	EA	EU MORTISE LOCK	L9092LEU 17A RX DPS CON 12/24 VDC	✓ 626	SCH
1	EA	PERMANENT CORE	AS REQUIRED	626	BES
1	EA	OH STOP	90S	630	GLY
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE
1	EA	CREDENTIAL READER	FURNISHED AND INSTALLED BY ACCESS CONTROL PROVIDER	✓	
1	EA	DIAGRAM	ELEVATION		DLR
1	EA	DIAGRAM	POINT TO POINT		DLR

COORDINATE WITH ELECTRICAL AND SECURITY. ENTRY BY CREDENTIAL OR KEY OVERRIDE.
PRESENTING VALID CREDENTIAL TO CARD READER LOCK WILL MOMENTARILY UNLOCK LOCK
AND ALLOW ENTRY.

UPON LOSS OF POWER DOOR IS LOCKED. DOOR IS ALWAYS AVAILABLE FOR FREE EGRESS.
DOOR CONTACT/RX TIED TO ACCESS CONTROL SYSTEM FOR MONITORING.

Hardware Group No. 20

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	45H-7-D-14H	626	BES
1	EA	PERMANENT CORE	AS REQUIRED	626	BES
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
3	EA	SILENCER	SR64	GRY	IVE

END OF SECTION 087100

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Doors.
 - 2. Storefront framing.
- B. Related Sections:
 - 1. Section 084113 "Aluminum Framed Entrances and Storefronts."

1.3 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
 - 1. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch (25 mm), whichever is less.
 - 2. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- C. Acoustic Performance:
 - 1. Interior Glazing: 40 STC.

1.4 ACTION SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.

- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved by coated-glass manufacturer.
- B. 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.
- C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- D. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.
- E. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.
- F. 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 or the manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- G. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, whether glazing is for use in fire doors or other openings, whether or not glazing passes hose-stream test, whether or not glazing has a temperature rise rating of 450 deg F (250 deg C), and the fire-resistance rating in minutes.
- H. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- I. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Review temporary protection requirements for glazing during and after installation.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.7 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. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F (4.4 deg C).

1.8 WARRANTY

- A. Manufacturer's Special Warranty for Glass Products: Manufacturer's standard form in which glass manufacturer agrees to replace glass units that deteriorate within specified warranty period. Deterioration of glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning glass contrary to manufacturer's written instructions.
 - 1. Warranty Period: 10 years from date of Final Acceptance.

PART 2 - PRODUCTS

2.1 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 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. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.2 GLASS PRODUCTS

- A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
- B. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
2. For uncoated glass, comply with requirements for Condition A.
3. Performance Values:
 - a. Light Transmission: 35 percent.
 - b. SHGC (TSET): 25percent.
 - c. U-Value: .25 Btu/hr./sf/F/

2.3 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.
- B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene, silicone or thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.
 1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.
- C. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock-strips, complying with ASTM C 542, black.

2.4 GLAZING SEALANTS

- A. General:
 1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
- B. Structural-Sealant Joints:
 1. Designed to carry gravity loads of glazing.

2.5 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated.

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.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

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 will 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. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. 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.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
 - 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 (3-mm) 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.
- H. 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.
- I. Set glass lites in each series with uniform pattern, draw, bow and similar characteristics.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.6 CLEANING AND PROTECTION

- A. Protect glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

- D. Wash glass on both exposed surfaces in each area of Project 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 gypsum board assemblies.
 - 2. Suspension systems for interior gypsum ceilings, soffits and grid systems.
 - 3. Suspension systems for interior metal systems.

- B. Related Requirements:

- 1. Section 054000 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; roof rafters and ceiling joists; and roof trusses.
 - 2. Section 055100 "Metal Stairs" for framing at solid surface material treads and risers.
 - 3. Section 095133 "Acoustical Metal Pan Ceilings."

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 DESCRIPTION

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
 - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.

2. Protective Coating: ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized, unless otherwise indicated.
- B. Studs and Runners: ASTM C 645.
 1. Steel Studs and Runners:
 - a. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).
 - b. Depth: As indicated on Drawings.
- C. Slip-Type Head Joints: Where indicated, provide the following:
 1. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Dietrich Metal Framing; SLP-TRK Slotted Deflection Track.
 - 2) Steel Network Inc. (The); VertiTrack VTD Series.
 - 3) Superior Metal Trim; Superior Flex Track System (SFT).
- D. Cold-Rolled Channel Bridging: Steel, 0.053-inch (1.34-mm) minimum base-metal thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
 1. Depth: 1-1/2 inches (38 mm).
 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.
- E. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
 1. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).
 2. Depth: 7/8 inch (22.2 mm) and 1-1/2 inches (38.1 mm).
- F. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (31.8 mm), wall attachment flange of 7/8 inch (22 mm), minimum uncoated-metal thickness of 0.018 inch (0.45 mm), and depth 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- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.
- B. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.
- C. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch (1.34 mm) and minimum 1/2-inch- (13-mm-) wide flanges.
 1. Depth: 2 inches (51 mm).

- D. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Armstrong World Industries, Inc.; Drywall Grid Systems.
 - b. Chicago Metallic Corporation; Drywall Grid System.
 - c. USG Corporation; Drywall Suspension System.

2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 - 1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide one of the following:
 - 1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No.1 5 asphalt felt), nonperforated.
 - 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754, except comply with framing sizes and spacing indicated.
 - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

- B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- C. Install bracing at terminations in assemblies.
- D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

- A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- B. Install studs so flanges within framing system point in same direction.
 - 1. Space studs at 16 inches (406 mm) o.c., unless otherwise indicated.
- C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
 - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
 - 6. Curved Partitions:
 - a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
 - b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches (150 mm) o.c.
- D. Z-Furring Members:
 - 1. Erect insulation (specified in Section 072100 "Thermal Insulation") vertically and hold in place with Z-furring members spaced 24 inches (610 mm) o.c.

2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
 3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (305 mm) from corner and cut insulation to fit.
- E. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.5 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 4. Do not attach hangers to steel roof deck.
 5. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 6. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 7. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

- F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 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. Cementitious backer units.

- B. Related Requirements:

- 1. Section 092216 "Non-Structural Metal Framing" for non-structural 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 recommendations, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E413 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CertainTeed Corp.
 - 2. Georgia-Pacific Gypsum LLC.
 - 3. Lafarge North America Inc.
 - 4. National Gypsum Company.
 - 5. USG Corporation.
- B. Gypsum Board, Type X: ASTM C 1396/C 1396M.
 - 1. Thickness: 5/8 inch (15.9 mm).
 - 2. Long Edges: Tapered.
- C. Gypsum Ceiling Board: ASTM C 1396/C 1396M.
 - 1. Thickness: 5/8 inch (15.9 mm).
 - 2. Long Edges: Tapered.
- D. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.
 - 1. Core: 5/8 inch (15.9 mm), Type X.
 - 2. Long Edges: Tapered.
 - 3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.4 TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or 1325, with manufacturer's standard edges.
 - 1. Products: Subject to compliance with requirements, provide one of the following:

- a. CertainTeed Corp.; FiberCement BackerBoard.
 - b. National Gypsum Company, Permabase Cement Board.
 - c. USG Corporation; DUROCK Cement Board.
2. Thickness: 5/8 inch (15.9 mm).
 3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

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. L-Bead: L-shaped; exposed long flange receives joint compound.
 - c. Expansion (control) joint.

2.6 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 75/C 475M.
- B. Joint Tape:
 1. Interior Gypsum Board: Paper.
 2. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
 1. Prefilling: At open joints 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.
- D. Joint Compound for Tile Backing Panels:
 1. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.7 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- 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 (0.84 to 2.84 mm) thick.
 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- 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.
1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- E. 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 framing, with Installer present, for compliance with requirements and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.

2. Fit gypsum panels around ducts, pipes, and conduits.
 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
1. Type X: As indicated on Drawings.
 2. Ceiling Type: Ceiling surfaces.
 3. Moisture- and Mold-Resistant Type: As indicated on Drawings.
- 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 vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
 3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Multilayer Application:
1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16

- inches (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
 3. Fastening Methods: Fasten base layers with screws; fasten face layers with adhesive and supplementary fasteners.
- D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.4 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.

3.5 INSTALLING TRIM ACCESSORIES

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

3.6 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 3: Where indicated on Drawings.
4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
5. Level 5: Where indicated on Drawings.
 - a. Primer and its application to surfaces are specified in other Section 099123 "Interior Painting."

- E. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.7 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 093000 - TILE

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 wall tile.
- 2. Aluminum trim.

- B. Related Sections:

- 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. Module Size: Actual tile size plus joint width indicated.
- C. Face Size: Actual tile size, excluding spacer lugs.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- C. Samples for Verification:
 - 1. Full-size units of each type and composition of tile and for each color and finish required.
 - 2. Full-size units of each type of trim and accessory.
 - 3. Stone thresholds in 6-inch (150-mm) lengths.
 - 4. Metal edge strips in 6-inch (150-mm) lengths.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern and size indicated.

1.6 QUALITY ASSURANCE

- A. Source Limitations for Tile: Obtain tile of each type from one 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 one manufacturer and each aggregate from one source or producer.
- C. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

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.
- E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.8 PROJECT 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 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 unless otherwise indicated.
- 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 TCA 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.
- E. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.2 TILE PRODUCTS

- A. Tile Type: Glazed wall tile.
 - 1. Basis of Design: Wall tile is based on Color Wheel Classic as manufactured by Daltile. Subject to compliance with requirements, the named product or comparable product by one of the following:
 - a. American Olean; Division of Dal-Tile International Inc.
 - b. Florida Tile Industries, Inc.
 - 2. Module Size: 3 by 6 inches (76 by 152 mm).
 - 3. Thickness: 5/16 inch (8 mm).
 - 4. Face: Plain with modified square edges or cushion edges.
 - 5. Finish: Manufacturer's standard.
 - 6. Tile Color and Pattern: As selected by Architect from manufacturer's full range.
 - 7. Grout Color: As selected by Architect from manufacturer's full range.
 - 8. Mounting: Factory, back mounted.
 - 9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile

2.3 TILE BACKING PANELS

- A. Cementitious Backer Units: As specified in Section 092900 "Gypsum Board."

2.4 SETTING MATERIALS

A. Dry-Set Portland Cement Mortar (Thin Set): ANSI A118.1.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Laticrete International, Inc.
 - b. MAPEI Corporation.
 - c. Summitville Tiles, Inc.
2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.1.

B. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Laticrete International, Inc.
 - b. MAPEI Corporation.
 - c. Summitville Tiles, Inc.
2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
3. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

2.5 GROUT MATERIALS

A. Standard Cement Grout: ANSI A118.6.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Laticrete International, Inc.
 - b. MAPEI Corporation.
 - c. Summitville Tiles, Inc.

2.6 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. 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.
- C. Grout Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

2.7 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 installed tile.
 - 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 installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
 - 3. 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. 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 TILE INSTALLATION

- A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA 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 TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
- 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. Jointing Pattern: Lay tile in pattern 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.
- F. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 - 1. Glazed Wall Tile: 1/16 inch (1.6 mm).
 - 2. Decorative Thin Wall Tile: 1/16 inch (1.6 mm).
- G. Grout Sealer: Apply grout sealer to cementitious grout joints 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 CLEANING AND PROTECTING

- A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. 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.
 - 2. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.
- B. Protect installed tile work during construction period to prevent staining, damage and wear.

END OF SECTION 093000

SECTION 095123 - ACOUSTICAL TILES

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. Acoustical tiles for interior ceilings and walls.
- B. Products furnished, but not installed under this Section, include anchors, clips and other ceiling attachment devices to be cast in concrete.

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 Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:
 - 1. Acoustical Tiles: Set of full-size Samples of each type, color, pattern, and texture.
 - 2. Exposed Moldings and Trim: Set of 6-inch- (150-mm-) long Samples of each type and color.

1.5 CLOSEOUT SUBMITTALS

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

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. Acoustical Ceiling Units: Full-size tiles equal to 2 percent of quantity installed.
 - 2. Suspension-System Components: Quantity of each concealed grid and exposed component equal to 2 percent of quantity installed.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical tiles, 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 tiles, permit them to reach room temperature and a stabilized moisture content.

1.8 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations:
 - 1. Suspended Acoustical Tile Ceilings: Obtain each type of acoustical ceiling tile and its suspension system from single source from single manufacturer.
- B. Basis of Design: Acoustical panels are based on Ultima Tegular as manufactured by Armstrong World Industries, Inc. Subject to compliance with requirements, provide the named products or comparable product by one of the following:
 - 1. CertainTeed Corp.
 - 2. USG Interiors, Inc.; Subsidiary of USG Corporation.

2.2 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Class A according to ASTM E1264.
 - 2. Smoke-Developed Index: 50 or less.

2.3 CEILING ACOUSTICAL TILES

- A. Acoustical Tile Standard: Provide manufacturer's standard tiles of configuration indicated that comply with ASTM E1264 classifications as designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
- B. Classification: Provide tiles as follows:

1. Type and Form: Type B, Form B2, fiberglass with acoustically transparent membrane with factory-applied painted finish.
 2. Pattern: G (smooth).
- C. Color: White.
- D. Light Reflectance (LR): Not less than 0.88.
- E. Ceiling Attenuation Class (CAC): Not less than 30.
- F. Noise Reduction Coefficient (NRC): Not less than 0.95.
- G. Articulation Class (AC): Not less than 190.
- H. Edge/Joint Detail: Square, tegular.
- I. Thickness: 1 inch (25.4 mm).
- J. Modular Size: As indicated in the Finish Schedule on the Drawings.
- K. 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 D3273, ASTM D3274, or ASTM G21 and evaluated according to ASTM D3274 or ASTM G21.

2.4 WALL ACOUSTICAL TILES

- A. Basis of Design: Wall acoustical tiles are based on Type M1XL as manufactured by BuzziTile. Subject to compliance with requirements, provide the named products or comparable products submitted and approved in accordance with Division 1 requirements.
- B. Classification: Provide tiles as follows:
1. Type and Pattern: As selected by the Architect from manufacturer's full range.
 2. Size and Shape: As indicated on the drawings.
- C. Noise Reduction Coefficient (NRC): Not less than 0.70.
- D. Edge/Joint Detail: Square.
- E. Thickness: Manufacturer's standard.
- F. Mounting: Adhesive attach to wall substrate.

2.5 METAL SUSPENSION SYSTEMS, GENERAL

- A. Direct-Hung, Double-Web Suspension System: Main and cross runners roll formed from and capped with cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 (Z90) coating designation.
1. Structural Classification: Heavy-duty system.

2.6 METAL SUSPENSION SYSTEM

- A. Basis of Design: Metal suspension system is based on Suprafine XL 9/16" manufactured by Armstrong World Industries, Inc. Subject to compliance with requirements, provide comparable product by one of the following:
 - 1. CertainTeed Corp.
 - 2. Chicago Metallic Corporation.
 - 3. USG Interiors, Inc.; Subsidiary of USG Corporation.
- B. Narrow-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 (Z90) coating designation; with prefinished 9/16-inch- (15-mm-) wide metal caps on flanges.
 - 1. Structural Classification: Heavy-duty system.
 - 2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
 - 3. Face Design: Flat, flush.
 - 4. Cap Material: Steel or aluminum cold-rolled sheet.
 - 5. Cap Finish: As indicated on Drawings to match Acoustical Tiles (White and Black).

2.7 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated.
- B. Wire Hangers: Provide wires as follows:
 - 1. Stainless-Steel Wire: ASTM A580/A580M, Type 304, nonmagnetic.
 - 2. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, Table 1, Direct Hung") will be less than yield stress of wire, but not less than 0.135-inch- (3.5-mm-) diameter wire.

2.8 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 complying with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for of suspension-system runners.
 - 1. Finish: Painted white.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing and substrates to which acoustical tile ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

- B. Examine acoustical tiles before installation. Reject acoustical tiles 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 tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles 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 OF SUSPENDED ACOUSTICAL TILE CEILINGS

- A. Install suspended acoustical tile ceilings according to ASTM C636/C636M and manufacturer's written instructions.
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 - 4. 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.
 - 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 deck tabs.
 - 8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 - 9. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
 - 10. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical tiles.

1. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends. Miter corners accurately and connect securely.
 2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical tiles in coordination with suspension system and exposed moldings and trim. Place splines or suspension-system flanges into kerfed edges of tiles so tile-to-tile joints are interlocked.
1. Fit adjoining tiles to form flush, tight joints. Scribe and cut tiles for accurate fit at borders and around penetrations through ceiling.
 2. Hold tile field in compression by inserting leaf-type, spring-steel spacers between tiles and moldings, spaced 12 inches (305 mm) o.c.

3.4 INSTALLATION OF ACOUSTICAL WALL TILES

- A. Install acoustical wall tiles according to manufacturer's written instructions.
- B. Wall surfaces shall be free of dirt, grease or any special paint finishes that could prevent the adhesive from properly adhering to the wall surface.
- C. Tile Spacing: As recommended by the manufacturer.

3.5 ERECTION TOLERANCES

- A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m), 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 (3 mm in 3.6 m), non-cumulative.

3.6 ADJUSTING

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

END OF SECTION 095123

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Resilient base.
 - 2. Resilient molding accessories.
- B. Related Sections:
 - 1. Section 096519 "Resilient Tile Flooring" for resilient floor tile.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches (300 mm) long, of each resilient product color, texture, and pattern required.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 QUALITY ASSURANCE

- A. Mockups: Provide resilient products with mockups specified in other Sections.

1.6 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 (10 deg C) or more than 90 deg F (32 deg C).

1.7 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), 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. Until Final Acceptance, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 RESILIENT BASE

- A. Resilient Base:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong World Industries, Inc.
 - b. Flexco, Inc.
 - c. Johnsonite.
 - d. Roppe Corporation, USA.
- B. Resilient Base Standard: ASTM F 1861.
 - 1. Material Requirement: Type TS (rubber, vulcanized thermoset).
 - 2. Manufacturing Method: Group I (solid, homogeneous).
 - 3. Style: Cove (base with toe).
- C. Minimum Thickness: 0.125 inch (3.2 mm).
- D. Height: 4 inches (102 mm).
- E. Lengths: Cut lengths 48 inches (1219 mm) long or coils in manufacturer's standard length.
- F. Outside Corners: Job formed.
- G. Inside Corners: Job formed.
- H. Color and Finish: As selected by Architect from manufacturer's full range.

2.2 RESILIENT MOLDING ACCESSORY

- A. Resilient Molding Accessory:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flexco, Inc.
 - b. Johnsonite.
 - c. Roppe Corporation, USA.
- B. Description: Carpet edge for glue-down applications and reducer strip for resilient floor covering.
- C. Material: Rubber.
- D. Profile and Dimensions: As indicated.
- E. Colors and Patterns: As selected by Architect from full range of industry colors.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, Portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit 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 tiles, 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.
- B. 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.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until they are same temperature as the space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- D. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

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 practicable without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Job-Formed Corners:
 1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends.
 2. Inside Corners: Use straight pieces of maximum lengths possible.

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 carpet and resilient floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.
- B. Perform the following operations immediately after completing resilient product installation:
 1. Remove adhesive and other blemishes from exposed surfaces.
 2. Damp-mop surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

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. Vulcanized rubber and cork floor tile.

- B. Related Sections:

- 1. Section 096513 "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with resilient floor coverings.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- 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. Use same designations indicated on Drawings.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.5 MATERIALS MAINTENANCE SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Floor Tile: Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

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.
 - 1. Engage an installer who employs workers for this Project who are trained or certified by manufacturer for installation techniques required.
- B. Fire-Test-Response Characteristics: 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.

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 (10 deg C) or more than 90 deg F (32 deg C). Store floor tiles on flat surfaces.

1.8 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), 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. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 RESILIENT FLOOR TILE

- A. Basis of Design: Resilient floor tile is based on Vulcanized Rubber + Cork manufactured by Siena, USA. Subject to compliance with requirements, provide the named products or comparable products by one of the following:
 - 1. Capri Collections.

2. Zandur Innovative Flooring.
- B. Tile Standard: ASTM F1344 – Rubber Floor Tile
 1. Class: Class 1.
 2. Type: Type A and B, Grade 1.
- C. Thickness: 0.20 inch (5.1mm).
- D. Size: 19-11/16" x 19-11/16" (500mm by 500mm).
- E. Colors and Patterns: As selected by Architect from full range of industry colors.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.

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.
- B. 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.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to 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 manufacturer. Do not use solvents.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

- D. Do not install floor tiles until they are same temperature as space where they are to be installed.
 - 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

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 in Ashlar Pattern or as indicated on the drawings.
- 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.
- 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, nonstaining marking device.
- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of 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 products 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, visible adhesive and surface blemishes from floor tile surfaces before applying liquid floor polish.
 - 1. Apply two coats.
- E. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SECTION 096813 – CARPET TILE

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 024119 "Selective Structure Demolition" for removing existing floor coverings.
 - 2. Section 096513 "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:
 - a. Review delivery, storage and handling procedures.
 - b. Review ambient conditions and ventilation procedures.
 - c. Review subfloor preparation procedures.

1.4 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. Shop Drawings: Show the following:
 - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets and locations where cutouts are required in carpet tiles.
 - 2. Carpet tile type, color and dye lot.
 - 3. Type of subfloor.
 - 4. Type of installation.
 - 5. Pattern of installation.
 - 6. Pattern type, location and direction.
 - 7. Pile direction.
 - 8. Type, color, and location of insets and borders.

9. Type, color, and location of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.

C. 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.

D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

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. (8.3 sq. m).

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.

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 are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.10 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
 - 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism or abuse.
 - 2. Failures include, but are not limited to, 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 Final Acceptance.

PART 2 - PRODUCTS

2.1 CARPET TILE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Milliken & Company.
 - 2. Mohawk Group (The); Mohawk carpet, LLC.
 - 3. Patcraft; a division of Shaw Industries, Inc.
- B. Color and Pattern: Match Architect's samples.
- C. Fiber Content: 100 percent nylon 6, or 100 percent nylon 6.
- D. Pile Characteristic: Tufted, Textured Loop.
- E. Primary Backing/Backcoating: Manufacturer's standard PVC-free composite materials.
- F. Secondary Backing: Manufacturer's standard material.
- G. Size: 50 cm x 50 cm.
- H. Applied Soil-Resistance Treatment: Manufacturer's standard material.
- I. Antimicrobial Treatment: Manufacturer's standard material.
- J. Performance Characteristics: As follows:
 - 1. Texture Appearance Retention Rating: Severe.
 - 2. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm.
 - 3. Dry Breaking Strength: Not less than 100 lbf (445 N) according to ASTM D 2646.
 - 4. Tuft Bind: Not less than 10 lbf (45 N) according to ASTM D 1335.
 - 5. Delamination: Not less than 4 lbf/in. (18 N/mm) according to ASTM D 3936.
 - 6. Dimensional Tolerance: Within 1/32 inch (0.8 mm) of specified size dimensions, as determined by physical measurement.
 - 7. Dimensional Stability: 0.2 percent or less according to ISO 2551 (Aachen Test).

8. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC 165.
9. Colorfastness to Light: Not less than 4 after 60 AFU (AATCC fading units) according to AATCC 16, Option E.
10. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.
11. Electrostatic Propensity: Less than 3.5 kV according to AATCC 134.

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.
- 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. 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 (3 mm) wide or wider and protrusions more than 1/32

inch (0.8 mm) unless more stringent requirements are required by manufacturer's written instructions.

- C. Remove coatings 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: As recommended in writing by carpet tile manufacturer.
- 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.
- H. Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
 - 1. Remove excess adhesive, 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 097726 – VINYL TRANSFER GRAPHICS

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 vinyl transfer graphics that are directly attached to vertical surfaces exposed to view.
- B. Related Requirements:
 - 1. Section 012300 "Alternates" for bid requirements affecting work in this section.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For each type of film showing the required finish(es).
- C. Product Schedule: For wall surfacing films. Use same designations indicated on Drawings or specified.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For wall surfacing films to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Regularly engaged in the manufacture of architectural finish films.
- B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- C. Mockups: Prepare mockups of vinyl transfer graphics for material and substrate indicated and each color and finish required to demonstrate aesthetic effects and to set quality standards for materials and execution. Duplicate appearance of approved Sample submittals.
 - 1. Locate mockups on existing surfaces where directed by Architect.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Final Acceptance.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace films that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes.
 - b. Deterioration of embedded graphic image.
 - c. Separation or delamination of sheet materials and components.
 - 2. Warranty Period: Five years from date of Final Acceptance.

PART 2 - PRODUCTS

2.1 VINYL TRANSFER GRAPHICS

- A. Vinyl Transfer Graphics: Custom punch card design graphic print.
 - 1. Description: Custom design graphics for field-applied application.
 - 2. Color(s) and Graphic(s): As selected by Architect from manufacturer's full range.
 - 3. Mounting: Surface mounted to substrates with pressure-sensitive adhesive.
- B. Basis of Design: Vinyl transfer graphics are based on products manufactured by Transfer Express. Subject to compliance with requirements, provide the named products or comparable products by one of the following:
 - 1. Decals.com.
 - 2. Sticker Genius.

2.2 ACCESSORIES

- A. Attachment: Manufacturer's standard adhesive or backing.

2.3 GENERAL FINISH REQUIREMENTS

- A. Protect finishes on exposed surfaces.
- B. Appearance of Finished Work: Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install vinyl transfer graphics using mounting methods indicated and according to manufacturer's written instructions.

1. Install films level, plumb, true to line and at locations and heights indicated, with finished surfaces free of distortion and other defects in appearance.
2. Before installation, verify that surfaces to receive graphics are clean and free of materials or debris that would impair installation.

B. Mounting Method:

1. Pressure-Sensitive Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Place film in position and push to engage adhesive.

3.2 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed graphics that do not comply with specified requirements. Replace graphics with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. On completion of installation maintain graphics in a clean condition during construction and protect from damage until Final Acceptance

END OF SECTION 097726

SECTION 098116 - ACOUSTICAL 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. Mineral glass-fiber blanket insulation.

1.3 ACTION SUBMITTALS

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

1.4 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.5 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 GLASS-FIBER BLANKET INSULATION

- A. Glass-Fiber Blanket Insulation, Non-combustible, lightweight, mineral wool batt insulation, unfaced: ASTM C665, Type I; passing ASTM E136 for combustion characteristics.
 - 1. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches (305 mm) and wider in width.
- B. Fire Performance:
 - 1. Non-Combustibility: ASTM E 136.
 - 2. Surface Burning Characteristics: ASTM E 84.

- a. Flame Spread: 0.
 - b. Smoke Developed: 0.
- C. Acoustical Performance:
 - 1. Airborne Sound Transmission Loss: ASTM E 90.
 - 2. Sound Insulation Rating: ASTM E 413.
 - 3. Sound Absorption Coefficients: ASTM C 423.
 - 4. Air Erosion Velocity: 1,000 ft/m maximum to UL 181.
 - 5. Thermal Resistance: ASTM C 518.
 - 6. Corrosion Resistance: ASTM 665. Corrosion to Steel: Pass.
 - 7. Stainless Steel Stress Corrosion: ASTM C 795.
 - 8. Density: ASTM C 167.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 INSTALLATION, GENERAL

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

3.3 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

- A. Glass-Fiber 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 (76-mm) 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 (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

3.4 PROTECTION

- A. Protect installed insulation from damage, 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 098116

SECTION 098433 - SOUND-ABSORBING 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 shop-fabricated, acoustical panel units tested for acoustical performance, including the following:
 - 1. Fixed sound-absorbing wall panels.
 - 2. Fixed sound-absorbing ceiling panels.
- B. Related Requirements:
 - 1. Section 095123 :”Acoustical Tiles” for acoustical wall tiles.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For unit assembly and installation.
 - 1. Include plans, elevations, sections and mounting devices and details.
 - 2. Include details at cutouts and penetrations for other work.
 - 3. Include direction of fabric weave and pattern matching.
- C. Samples for Verification: For the following products:
 - 1. Panel: 12-inch- (300-mm-) long Sample(s) showing each edge profile, corner and finish.
 - 2. Mounting Devices: Full-size Samples.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of unit to include in maintenance manuals. Include fabric manufacturers' written cleaning and stain-removal instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with fabric and unit manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.
- B. Deliver materials and units in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not install units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work at and above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Lighting: Do not install units until a permanent level of lighting is provided on surfaces to receive the units.
- C. Field Measurements: Verify unit locations and actual dimensions of openings and penetrations by field measurements before fabrication and indicate them on Shop Drawings.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace units and components that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to the following:
 - a. Acoustical performance.
 - b. Warping of core.
 - 2. Warranty Period: Two years from date of Final Acceptance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain wall units specified in this Section from single source from single manufacturer.
- B. Wall Panels:
 - 1. Basis of Design: Sound absorbing wall units are based on products manufactured by Homasote. Subject to compliance with requirements, provide the named products or comparable products by one of the following:
 - a. Johns Manville.
 - b. Thermafiber.
- C. Ceiling Panels:
 - 1. Basis of Design: Sound absorbing ceiling units are based on Tectum Direct-Attached as manufactured by Armstrong World Industries. Subject to compliance with requirements, provide the named products or comparable products by one of the following:
 - a. Acoustical Surfaces, Inc.
 - b. Soundproofing America.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: Units shall comply with "Surface-Burning Characteristics" or "Fire Growth Contribution" Subparagraph below, or both, as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
1. Surface-Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 2. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 Method B Protocol or NFPA 286.

2.3 SOUND-ABSORBING WALL UNITS (W50)

- A. Sound-Absorbing Wall Panel: Manufacturer's standard panel construction consisting compressed wood strands.
1. Panel Shape: Flat.
 2. Mounting: Manufacturer's standard direct attachment.
 3. Core: Manufacturer's standard.
 4. Edge Profile: Square.
 5. Nominal Overall Panel Thickness: 1/2 inch (12.7 mm).
 6. Panel Dimensions: As indicated on Drawings.
- B. Sound-Absorbing Ceiling Panel: Manufacturer's standard panel construction consisting compressed wood strands.
1. Panel Shape: Flat.
 2. Mounting: Manufacturer's standard direct attachment.
 3. Core: Manufacturer's standard.
 4. Facing Material: Cementitious wood fiber.
 5. Edge Profile: Square.
 6. Nominal Overall Panel Thickness: 1 inch (25.4 mm).
 7. Panel Dimensions: As indicated on Drawings.
 8. Noise Reduction Coefficient (NRC): 40.
 9. Finish: Factory primed for field painting.
 - a. Color and Face Pattern: As selected by the Architect from manufacturer's full range.

2.4 FABRICATION

- A. Standard Construction: Use manufacturer's standard construction unless otherwise indicated with rigid edges to reinforce panel perimeter against warpage and damage.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine wall and ceiling units, substrates, areas and conditions for compliance with requirements, installation tolerances and other conditions affecting unit performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install units in locations indicated. Unless otherwise indicated, install units with surfaces and edges plumb, level and in alignment with other units, faces flush and scribed to fit adjoining work accurately at borders and at penetrations.
- B. Comply with manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.

3.3 INSTALLATION TOLERANCES

- A. Variation from Plumb and Level: Plus or minus 1/16 inch (1.6 mm) in 48 inches (1200 mm), noncumulative.
- B. Variation of Joint Width: Not more than 1/16-inch (1.6-mm) variation from reveal line in 48 inches (1200 mm), noncumulative.

3.4 CLEANING AND PROTECTION

- A. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.
- B. Protect sound absorbing wall units from dust and other construction activities until Substantial Completion.

END OF SECTION 098433

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Primers.
 - 2. Water-based finish coatings.
 - 3. Two component DTM urethane mastic coatings.
 - 4. Floor stain and sealers.
- B. Related Requirements:
 - 1. Section 099600 "High Performance Coatings" for finishing galvanized metal substrates.
 - 2. Section 099646 "Intumescent Painting" for painting structural steel and other designated components.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include preparation requirements and application instructions.
 - 2. Indicate VOC content.
- B. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches (200 mm) 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 Schedule: Use same designations indicated on Drawings and in the Interior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint Products: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.6 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- B. Stained Concrete Mockups: Include (3) 3'x3' mock ups per color. Mock up shall include saw cuts (edge condition), slab prep and finish coats/sealer, to evaluate and determine color formulation/number of coats. Stained concrete will require clean edge - protect adjacent areas not to receive stain.

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 (10 and 35 deg C).
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures of less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each paint product from single source from single manufacturer.

- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Benjamin Moore.
 - 2. Duron Paints and Wallcoverings.
 - 3. ICI Dulux Paints.
 - 4. Pratt and Lambert Paints.
 - 5. PPG Industries, Inc.
 - 6. Sherwin-Williams.

2.2 PAINT PRODUCTS, GENERAL

- A. Material Compatibility:
 - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- B. Colors: As selected by Architect from manufacturer's full range.

2.3 WATER-BASED FINISH COATS

- A. Interior, Latex, Low Sheen: Pigmented, water-based paint for use on primed/sealed interior gypsum board.
 - 1. Gloss and Sheen Level: Manufacturer's standard low-sheen finish.
- B. Interior, Latex: Pigmented, water-based paint for use on primed/sealed interior gypsum board and wood.
 - 1. Gloss and Sheen Level: Manufacturer's standard eggshell and semi-gloss finishes.

2.4 FLOOR SEALERS AND STAINS

- A. Acrylic Floor Sealer, Low Gloss: Acrylic-based, clear coating, for alkali and incidental water resistance and for use on concrete surfaces subject to low to medium foot traffic.
 - 1. Gloss and Sheen Level: Manufacturer's standard low-gloss finish.
- B. Interior Concrete Stain: Penetrating semitransparent stain for existing concrete horizontal surfaces.
 - 1. Basis of Design: Concrete stain is based on Formula One Liquid Dye Concentrate as manufactured by Scofield. Subject to compliance with requirements, provide the named product or comparable product submitted and approved in accordance with Division 1 requirements.

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. Masonry: 12 percent.
 - 2. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- 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.
- F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 INSTALLATION

- A. Apply paints according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire-Suppression, Plumbing, HVAC, Electrical, Communication and Electronic Safety and Security Work:
1. Paint the following work where exposed in occupied areas and equipment rooms:
 - a. Uninsulated metal piping.
 - b. Uninsulated plastic piping.
 - c. Pipe hangers and supports.
 - d. Metal conduit.
 - e. Plastic conduit.

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.
1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
 2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.

3. Allow empty paint cans to dry before disposal.
- 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: Floor System: Clear.
 1. Acrylic Epoxy Floor System:
 - a. Two coats acrylic epoxy concrete clear floor sealer, low gloss.
- B. Concrete: Floor System: Stained.
 1. Acrylic Floor System:
 - a. Two coats semi-transparent stain.
 - b. Two coats acrylic floor sealer, high gloss.
- C. Concrete: Columns:
 1. Acrylic Latex System:
 - a. One coat interior latex primer sealer.
 - b. Two coats acrylic latex enamel.
- D. Gypsum Board Walls:
 1. Latex System:
 - a. Prime Coat: Interior latex primer sealer.
 - b. Two coats interior, latex, eggshell.
- E. Gypsum Board Ceilings:
 1. Latex System:
 - a. Prime Coat: Interior latex primer sealer.
 - b. Two coats interior, latex, flat.
- F. Wood Stair Treads:
 1. Varnish, Exterior, Aliphatic Polyurethane, Two Component: Two coats, solvent-based, two-component, aliphatic polyurethane clear coating for wood surfaces; semi-gloss.
- G. Hollow Metal Doors and Frames:

1. Latex System:
 - a. Prime Coat: Shop primer specified in Section where substrate is specified.
 - b. Two coats interior, latex enamel, semi-gloss.

H. Intumescent-Coated Substrates:

1. Per intumescent paint manufacturer's approval and specifications.

END OF SECTION 099123

SECTION 099600 - HIGH-PERFORMANCE COATINGS

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 high-performance coating systems.
 - 1. Interior Substrates:
 - a. Galvanized metal.
 - b. Gypsum board (epoxy).
- B. Related Requirements:
 - 1. Section 099123 "Interior Painting" for general field painting.
 - 2. Section 099646 "Intumescent Painting" for painting structural steel and other designated components.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples for Verification: For each type of coating system and each color and gloss of topcoat indicated.
 - 1. Submit Samples on rigid backing, 8 inches (200 mm) 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.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Coatings: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

- A. Apply coatings only when temperature of surfaces to be coated and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
- C. Do not apply exterior coatings in snow, rain, fog or mist.

PART 2 - PRODUCTS

2.1 INTERIOR AND INTERIOR HIGH-PERFORMANCE EPOXY COATINGS

- A. Epoxy Coating Systems: Provide the following finish systems on the indicated exterior and interior substrates.
 1. Basis of Design: High performance coatings are based on Sherwin-Williams Company products in PART 3 Exterior and Interior High Performance Coating Schedules. Subject to compliance with requirements, provide the named products, or comparable products by one of the following:
 - a. Benjamin Moore & Co.
 - b. Duron, Inc.
 - c. ICI Paints, Devoe Coatings.
 - d. PPG Architectural Finishes, Inc.

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. 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 coating 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 coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
- D. 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.
- E. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.

3.3 APPLICATION

- A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
 1. Use applicators and techniques suited for coating and substrate indicated.
 2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
 3. Coat backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.
- D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating operation. Correct damage to work of other trades by cleaning, repairing, replacing, and recoating, 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 coated surfaces.

3.5 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Galvanized-Metal Substrates:

1. Pigmented Polyurethane over Epoxy Primer System: Sherwin Williams Pro Industrial Acrolon 100 Waterbased Urethane Gloss, B65-920 Series
 - a. Prime Coat: Primer, epoxy, anti-corrosive, for metal. Sherwin Williams Recoatable Epoxy Primer, B67A5
 - b. 2 Coats: Polyurethane, two component, pigmented, gloss matching topcoat.

B. Gypsum Board Substrates: (Toilet Walls)

1. Epoxy-Modified Latex: Sherwin Williams Pro Industrial Water based Catalyzed Epoxy Gloss, B73-310 Series
 - a. Prime Coat: Primer sealer, latex, interior. Sherwin Williams ProMar 200 0 VOC Latex Primer, B28W12600
 - b. 2 Coats: Pro Industrial water based epoxy.

END OF SECTION 099600

SECTION 101419 - DIMENSIONAL LETTER SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Cutout dimensional characters.
 - 2. Illuminated interior dimensional characters.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For dimensional letter 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 others, and accessories.
 - 3. Show message list, typestyles, graphic elements and layout for each sign at least half size.
- 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. Dimensional Characters: Full-size Sample of dimensional character.
- D. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.

1.4 CLOSEOUT SUBMITTALS

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

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Separation or delamination of sheet materials and components.
 - 2. Warranty Period: Five years from date of Final Acceptance.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 DIMENSIONAL CHARACTERS

- A. Cutout Characters: Characters with uniform faces; square-cut, smooth, eased edges; precisely formed lines and profiles; and as follows:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Gemini Signage, Inc.
 - b. ASI Sign Systems, Inc.
 - c. InPro Corporation.
 - 2. Character Material: Sheet or plate aluminum, ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
 - 3. Character Height: As indicated.
 - 4. Thickness: Manufacturer's standard for size of character.
 - 5. Finishes: As indicated.
 - 6. Mounting: As indicated.
 - 7. Typeface: As indicated.
- B. Illuminated Dimensional Characters
 - 1. Basis of Design: Illuminated dimensional characters are based on Face-Lit Acrylic channel letters as manufactured by Gemini Signage, Inc. Subject to compliance with requirements, provide the named products or comparable product by one of the following:
 - a. Moss, Inc.
 - b. Steel Art
 - 2. Classification: Provide face-illuminated signage complying as follows:
 - a. Material: light-diffusing acrylic with integrated LEDs
 - b. Color: To be selected from Manufacturer's full range
 - c. Size: As indicated on Drawings

- d. Depth: 1-1/2-inches (38.1 mm).
- e. LED color: White.

2.3 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:
 - 1. Use concealed fasteners and anchors unless indicated to be exposed.

2.4 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. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
 - 4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 - 5. Internally brace signs for stability and for securing fasteners.
 - 6. Provide rebates, lugs, and brackets 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.
 - 7. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.

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.
- C. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.6 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.
- B. Color Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.

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 signage work.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
 - 1. Install signs level, plumb, true to line and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Mounting Methods:
 - 1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

3.3 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.

- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101419

SECTION 101425 - ROOM-IDENTIFICATION PANEL SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes room-identification signs that are directly attached to the building.

1.3 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 least half size.
- 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. 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.

1.4 CLOSEOUT SUBMITTALS

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

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.6 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 Final Acceptance.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design".

2.2 ROOM-IDENTIFICATION SIGNS

- A. Room-Identification Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners and precisely formed lines and profiles; and as follows:
 1. Laminated-Sheet Sign: Photopolymer face sheet with raised graphics laminated to acrylic backing sheet to produce composite sheet.
 - a. Composite-Sheet Thickness: Manufacturer's standard for size of sign.
 - b. Surface-Applied Graphics: Applied vinyl film.
 - c. Color(s): As selected by Architect from manufacturer's full range.
 2. Sign-Panel Perimeter: Finish edges smooth.
 - a. Edge Condition: Square cut.
 - b. Corner Condition in Elevation: Rounded to radius indicated.
 3. Mounting: Surface mounted to wall with adhesive.
 4. Text and Typeface: Accessible raised characters and Braille.

2.3 SIGN MATERIALS

- A. Acrylic Sheet: ASTM D4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
- B. Vinyl Film: UV-resistant vinyl film with pressure-sensitive, permanent adhesive; die cut to form characters or images as indicated on Drawings.

2.4 ACCESSORIES

- A. 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.

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.

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. 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.

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 101425

SECTION 101473 - PAINTED SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Field-lettered signs painted directly on substrates in good condition.

- B. Related Requirements:

- 1. Section 057000 "Decorative Metal" for surfaces to receive painted signage.
 - 2. Section 081113 "Hollow Metal Doors and Frames" for surfaces to receive painted signage.
 - 3. Section 101425 "Room Identification Panel Signage" for field-applied, vinyl-character signs.

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. Shop Drawings: For painted signs.

- 1. Show sign locations and heights.
 - 2. Show message list, typestyles, graphic elements and layout for each sign at least half size.

- C. Samples: For each type of paint, paint system, color and gloss; on hardboard.

- D. Product Schedule: For painted signs. Use same designations indicated on Drawings or specified.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra paint materials, from the same production run, that match products applied and that are packaged with protective covering for storage and identified with labels describing contents, including material, finish, source, and sign location on building.

1. Quantity: Furnish Owner with an additional 3 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.6 QUALITY ASSURANCE

- A. Mockups: Prepare mockups of painted signs for each type of sign material and substrate indicated and each color and finish required to demonstrate aesthetic effects and to set quality standards for materials and execution. Duplicate appearance of approved Sample submittals.
 1. Locate mockups on existing surfaces where directed by Architect.
 2. Sign Mockups: Two sign texts that represent surfaces and conditions for signage application under same conditions as the completed Work.
 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Final Acceptance.

1.7 FIELD CONDITIONS

- A. Weather Limitations: Proceed with painting signs only when existing and forecasted weather conditions are within the environmental limits set by each manufacturer's written instructions and specified requirements.
- B. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

PART 2 - PRODUCTS

2.1 SIGN-PAINT MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Benjamin Moore.
 2. Duron Paints and Wallcoverings.
 3. ICI Dulux Paints.
 4. Pratt and Lambert Paints.
 5. PPG Industries, Inc.
 6. Sherwin-Williams.

2.2 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design".

2.3 PAINTED SIGNS

- A. Painted Sign: Sign painted directly on indicated substrate, including primers, sealers, undercoats and transition coats as required.
 - 1. Paint Type: Epoxy or polyurethane.
 - a. Gloss: Semi-gloss.
 - 2. Substrate: As indicated on Drawings.
 - 3. Text and Typeface: As indicated on Drawings.
 - a. Size: As indicated on Drawings.
 - b. Color: As selected by the Architect.

2.4 PAINT MATERIALS

- A. Sign Paints and Coatings: Inks, dyes and paints that are recommended in writing by manufacturer for optimum adherence to substrate and are UV and water resistant for colors and exposure indicated.
 - 1. Compatibility: Provide paint materials that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance. Comply with paint manufacturer's written instructions for inspection.
- B. If existing surfaces cannot be prepared to an acceptable condition for proper painting, notify Architect in writing.
- C. Proceed with installation only after unsatisfactory conditions have been corrected and surface is dry.
 - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 INSTALLATION

- A. Appearance Standard: Completed sign work shall have a sharp and uniformly delineated appearance as viewed by Architect from building interior at 10 feet (3 m) away from painted surface.
- B. Comply with manufacturers' written instructions for surface preparation and paint-application for each substrate condition.

- C. Apply primers, sealers and undercoats so that they do not extend beyond the limits of the painted signage. Remove excess without damaging the substrate.
- D. Install signs level, plumb, true to line, with uniform delineation and borders and at locations and heights indicated.
- E. Accessible Signage: Install in locations on walls as indicated on Drawings and according to accessibility standard.
- F. Signs Painted on Glass: Provide opaque paint matching painted sign material and finish onto opposite side of glass to conceal back of sign.

3.3 ADJUSTING AND CLEANING

- A. Remove and reapply damaged or deformed signs and signs that do not comply with specified requirements. Reapply signs with damaged or deteriorated finishes that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. After completing sign 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. Remove temporary protective coverings and strippable films as signs are installed.

END OF SECTION 101473

SECTION 104415 - FIRE-PROTECTION SPECIALTIES

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. Portable fire extinguishers.
 - 2. Fire-protection cabinets for portable fire extinguishers.

1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection cabinets.
 - 1. Fire Extinguishers: Include rating and classification.
 - 2. 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.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fire extinguishers and fire-protection cabinets through one source from a single manufacturer.
- B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1.5 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

1.6 FIRE EXTINGUISHER CERTIFICATION

- A. General: All fire extinguishers shall be inspected and tagged by a certified agency acceptable to authorities having jurisdiction. This certification is required of all fire extinguishers and shall be conducted at a time that will not delay the date of Final Acceptance.

1. Upon certification of each fire extinguisher, the manufacturer's tag shall be removed and a new tag installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. JL Industries, Inc.
 2. Larsen's Manufacturing Company.
 3. Potter Roemer; Div. of Smith Industries, Inc.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
- B. Stainless-Steel Sheet: ASTM A 666, Type 304.
- C. Tempered Break Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 1.5 mm thick.

2.3 FIRE EXTINGUISHERS

- A. General: Provide fire extinguishers of type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.
 1. Valves: Manufacturer's standard.
 2. Handles and Levers: Stainless steel.
 3. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.
- B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 4-A:60-B:C, 10-lb (4.5-kg) nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.4 FIRE-PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.
- B. Cabinet Construction: Nonrated, unless installed in fire-rated construction.
 1. Fire Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.0428-inch (1.1-mm) thick, cold-rolled steel sheet lined with minimum 5/8-inch (16-mm) thick, fire barrier material. Provide factory drilled mounting holes.
- C. Cabinet Material: Enameled-steel sheet.
- D. Recessed Cabinet:

1. Trimless with Concealed Flange: Surface of surrounding wall finishes flush with exterior finished surface of cabinet frame and door, without overlapping trim attached to cabinet. Provide recessed flange, of same material as box, attached to box, to act as drywall bead.
 - E. Cabinet Trim Material: Same material and finish as door.
 - F. Door Material: Stainless-steel sheet.
 - G. Door Style: Fully glazed panel with frame.
 - H. Door Glazing: Tempered break glass.
 - 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. Door Lock: Cylinder lock, keyed alike to other cabinets.
 3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated below.
 - a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
 - 1) Location: Applied to cabinet glazing.
 - 2) Application Process: Pressure-sensitive vinyl letters.
 - 3) Lettering Color: Red.
 - 4) Orientation: Vertical.
 - K. Finishes:
 1. Interior of Cabinet.
 - a. Baked enamel.
 - b. Color and Texture: White.
 2. Door and Frame:
 - a. Stainless Steel: No. 4 (satin) finish.
- 2.5 FABRICATION
- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
 1. Weld joints and grind smooth.

- a. Provide factory-drilled mounting holes.
 - B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
 - 1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch (13 mm) thick.
 - 2. Miter and weld perimeter door frames.
 - C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.
- 2.6 FINISHES, GENERAL
- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
 - C. Finish fire-protection cabinets after assembly.
 - D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- 2.7 STEEL FINISHES
- A. Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond using manufacturer's standard methods.
 - B. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).
- 2.8 STAINLESS-STEEL FINISHES
- A. General: Remove tool and die marks and stretch lines or blend into finish.
 - 1. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
 - B. Satin, Directional Polish: No. 4 finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for hose and cabinets to verify actual locations of piping connections before cabinet installation.
- B. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare recesses for semi-recessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

- A. General: Install fire-protection specialties in locations and at mounting heights indicated or, if not indicated, at heights indicated below.
 - 1. Fire-Protection Cabinets: 54 inches (1372 mm) above finished floor to top of cabinet.
- B. Fire-Protection Cabinets: Fasten fire-protection cabinets to structure, square and plumb.
 - 1. Provide inside latch and lock for break-glass panels.
 - 2. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.
- C. Identification:
 - 1. Cabinet: Apply vinyl lettering at locations indicated.

3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire-protection specialties are installed, unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet manufacturer.

- E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104415

SECTION 105613 - METAL STORAGE SHELVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Wall-mounted metal storage shelving.
- B. Coordinate sizes and locations of blocking and backing required for installation of metal storage shelving attached to wall and ceiling assemblies.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, construction details, material descriptions, dimensions of individual components and profiles and finishes for metal storage shelving.
- B. Shop Drawings: For metal storage shelving.
 - 1. Include plans, elevations, sections and attachment details.
- C. Samples for Verification: For the following components, of size indicated below:
 - 1. Vertical Supports: 12 inches (305 mm) tall.
 - 2. Shelves: Full size, but not more than 24 inches wide by 12 inches deep (610 mm wide by 305 mm deep).

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal storage shelving to include in maintenance manuals.

1.6 QUALITY ASSURANCE

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

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install metal storage shelving until spaces are enclosed and weathertight, wet work in spaces is complete and dry and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at levels intended for building occupants during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 WALL-MOUNTED METAL STORAGE SHELVING

- A. Basis of Design: Wall-mounted metal shelving is based on Rakks Model SA-06 as manufactured by Rangine Corporation. Subject to compliance with requirements, provide the named products or comparable products submitted and approved in compliance with Division 1 requirements.
- B. Load-Carrying Capacity per Shelf: 150 lb (68 kg).
- C. Shelving Material: 6063-T6 extruded aluminum.
- D. Sizes: As indicated.
- E. Finish: Clear anodized.
- F. Overall Unit Width, Depth and Height: As indicated.
- G. Accessories:
 - 1. Wall Standards: Rakks C-standard, surface and/or recessed mounted, as indicated.
 - 2. Supporting Brackets: Rakks T-style.

2.2 ANCHORS

- A. Wall Anchors: Manufacturer's standard anchors designed to secure metal storage shelving to adjacent wall.

2.3 FABRICATION

- A. Fabricate metal storage shelving components to provide field-assembled units that are square and rigid, with shelves flat and free of dents or distortion. Fabricate connections to form a rigid structure, free of buckling and warping.
 - 1. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Locate joints where least conspicuous.
- B. Form metal in maximum lengths to minimize joints.
- C. Form edges and corners free of sharp edges or rough areas. Remove burrs.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine walls to which metal storage shelving will be attached for properly located blocking, grounds or other solid backing for attachment of support fasteners.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install metal storage shelving level, plumb, square, rigid, true and with shelves flat and free of dents or distortion. Make connections to form a rigid structure, free of buckling and warping.
 - 1. Install exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
 - 2. Install shelves in each shelving unit at spacing indicated on Drawings.

3.3 ERECTION TOLERANCES

- A. Erect metal storage shelving to a maximum tolerance from vertical of 1/2 inch (13 mm) in up to 10 feet (3 m) of height, not exceeding 1 inch (25 mm) for heights taller than 10 feet (3 m).

3.4 ADJUSTING

- A. Touch up marred finishes or replace metal storage shelving that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by metal storage shelving manufacturer.
- B. Replace metal storage shelving components that have been damaged beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 105613

SECTION 123665 - 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. Quartz agglomerate countertops.
 - 3. Phenolic composite countertops.
 - 4. Counter support brackets.
- B. Related Sections:
 - 1. Section 064023 "Interior Architectural Woodwork" for wood countertops.
 - 2. Section 064116 "Plastic-Laminate-Faced Architectural Cabinets" for laminate-clad cabinets and shelving.

1.3 ACTION SUBMITTALS

- A. Product Data: For the following;
 - 1. Countertop materials.
 - 2. Abrasive nosings.
- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
- C. Samples for Verification: For the following products:
 - 1. Countertop material, 6 inches (150 mm) square.

1.4 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.5 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 COUNTERTOPS

- A. Fabrication: Fabricate tops in one piece with shop-applied edges unless otherwise indicated. Comply with manufacturer's written instructions for adhesives, sealers, fabrication and finishing.
 - 1. Fabricate with loose backsplashes for field assembly.

2.2 SOLID-SURFACE-MATERIAL COUNTERTOPS

- A. Basis of Design: Solid surface material is based on Corian as manufactured by E. I. DuPont de Nemours, Inc. Subject to compliance with requirements, provide the named product or comparable product submitted and approved in accordance with Division 1 requirements.
- B. Configuration: Provide countertops with the following front and backsplash style:
 - 1. Front: 1-1/2-inch (38-mm) laminated bullnose.
 - 2. Backsplash: Straight, slightly eased at corner.
 - 3. Endsplash: Matching backsplash.
- C. Countertops: 1/2-inch- (12.7-mm-) thick, solid surface material with front edge built up with same material.
- D. Backsplashes: 1/2-inch- (12.7-mm-) thick, solid surface material.
- E. Fabrication: Fabricate tops in one piece with shop-applied edges unless otherwise indicated. Comply with solid-surface-material manufacturer's written instructions for adhesives, sealers, fabrication and finishing.
 - 1. Fabricate with loose backsplashes for field assembly.

2.3 QUARTZ AGGLOMERATE COUNTERTOPS

- A. Basis of Design: Quartz agglomerate countertops are based Soapstone Metropolis as manufactured by. MSI. Subject to compliance with requirements, provide the named products or comparable products by one of the following:
 - 1. Corian Quartz.
 - 2. Silestone Quartz.
- B. Configuration: Provide countertops with the following front and backsplash style:
 - 1. Fronts and Sides: Waterfall edge.
- C. Countertops: 1-3/16-inches- (3-cm-) thick, quartz agglomerate with front edge built up with same material.
- D. Backsplashes: 1-3/16-inch- (3-cm-) thick, quartz agglomerate material.

- E. Fabrication: Fabricate tops in one piece with shop-applied edges unless otherwise indicated. Comply with quartz agglomerate manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
- F. Color: As selected by the Architect from manufacturer's full range.

2.4 PHENOLIC COMPOSITE COUNTERTOPS

- A. Phenolic Composite: Solid, high-pressure decorative laminate, complying with NEMA LD 3, Grade CGS.
 - 1. Chemical Resistance: Composite countertop material has the following ratings when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.4.5:
 - a. No Effect: Acetic acid (98 percent), acetone, ammonium hydroxide (28 percent), ethyl acetate, ethyl alcohol, formaldehyde (37 percent), furfural, phosphoric acid (85 percent), sulfuric acid (33 percent).
 - 2. Color: As selected by Architect from phenolic-composite manufacturer's full range.

2.5 GROMMETS: Square metal, with cover.

- 1. Material: Brass.
- 2. Size: 1.5-inches diameter.
- 3. Locations: As indicated on the drawings.

2.6 ABRASIVE NOSINGS

- A. Single Part Unit: Aluminum with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Fabricate units in lengths necessary to accurately fit openings or conditions.
 - 1. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
 - a. Nystrom.
 - b. Wooster Products, Inc.
 - c. ACL Industries.
 - 2. Provide ribbed bar abrasive. Aluminum alternating with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder.
 - 3. Nosing Type: Inset, Square Front and Back: 1-3/8 inches (35 mm).
 - a. Attachment Method: Drilled Hole, Mechanically Fastened.
 - 4. Finish: 6063-T5 aluminum, mill finish.
 - 5. Abrasive Color: Black.

2.7 COUNTER SUPPORT BRACKETS

- A. Manufacturer" Subject to compliance with requirements, provides by one of the following:
 - 1. A & M Hardware.
 - 2. Brunswick.
 - 3. Rakks.

- B. Locations: As indicated on the drawings.
- C. Weight Capacity: 450 lbs.
- D. Fasteners: As recommended by the manufacturer.
- E. Color: As selected by the Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install countertops level to a tolerance of 1/8 inch in 8 feet (3 mm in 2.4 m).
- B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Pre-drill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- C. Counter Support Brackets: Recess-mount as indicated on the Drawings. Fasteners shall be as required for the substrates. Bracket spacing shall be as indicated.

END OF SECTION 123665

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 033000 "Cast-in-Place Concrete" for setting sleeves, inserts and anchoring devices in concrete.
 - 2. Section 087100 "Door Hardware" for door hardware.

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, details, attachments to other work 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 (75 mm) square.

2. Tubular Products and Running Trim: Manufacturer's standard-size unit, 6 inches (150 mm) long.
3. Hardware: Manufacturer's standard, exposed, door-operating device.

1.5 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 two-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.

1.6 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.

1.7 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: Five years from date of Final Acceptance.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines.
- B. Regulatory Requirements: Comply with ASME A18.1, "Safety Standard for Platform Lifts and Stairway Chairlifts."

- C. Fire-Rated, Runway-Enclosure Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252.

2.2 VERTICAL PLATFORM LIFT

- A. Hydraulic Vertical Platform Lift, General: Pre-engineered lift system.
 - 1. Basis of Design: Vertical platform lift is based on V1504-STD manufactured by Savaria. Provide the named products, comparable products by one of the following, or equal product subject to compliance with the requirements:
 - a. National Wheel-O-Vator Co., Inc. (The); a division of ThyssenKrupp Access.
 - b. Butler Mobility Products; division of Butler Dynamics, LLC
- B. Number of Stops: Two.
- C. Car Size: 36 by 54 inches (914 by 1371 mm).
- D. Car Configuration: Enter/Exit same side.
- E. Pit Depth: 3-inches.
- F. Weight Capacity: 750 lbs.
- G. Rated Speed: 20 fpm (0.10 m/s).
- H. Power Supply: 120 V, 60 Hz, one phase.
- I. Drive System: 2:1 Roller chain hydraulic
- J. Motor/Pump: 1 HP (112 kw), gear type.
- K. Emergency Operation: Provide battery power system to raise or lower unit in case of malfunction or power loss.
- L. Self-Supporting Unit: Support vertical loads of unit only at base, with lateral support only at landing levels.
- M. Accessories: Provide units with the following accessories:
 - 1. Forced Ventilation System: Minimum one air change per minute and with auxiliary power source to operate ventilation for one hour in case of power failure.
- N. Car Enclosure: Side guards of platform shall have a steel frame with a powder coat finish and steel panel inserts to a minimum of 42 inches height.
- O. Doors and Gates:
 - 1. First Landing Door:
 - a. Door type: 80" low profile aluminum door with a concealed electro/mechanical interlock.
 - b. Flush closing operation with hoistway side.

- c. Operation: Manual with hydraulic closer.
 - d. Width: 36-inches clear opening.
- 2. Upper Floor Landing Door:
 - a. Door type: 80" low profile aluminum door with a concealed electro/mechanical interlock.
 - b. Flush closing operation with hoistway side.
 - c. Operation: Manual with hydraulic closer.
 - d. Width: 36-inches clear opening.
- P. Call Stations: Provide keyed (removable in on/off position) flush or surface mounted landing call/send stations.
- Q. Car Operation:
 - 1. Car Operating Panel shall consist of constant pressure buttons, emergency stop/alarm button, on/off key switch (when applicable) and emergency LED light mounted on a removable stainless steel panel (Type 304 #4 Stainless Steel Finish).
 - 2. Auxiliary lighting: The car shall be equipped with a battery operated LED light fixture. The battery shall be the rechargeable type with an automatic recharging system.
- R. Pumping Unit and Control: The pumping unit and control shall be enclosed in the tower. The controller and pump unit shall be pre-wired and tested prior to shipment. The controller is to be relay logic based operation for ease of maintenance and service.
- S. Cylinder And Plunger:
 - 1. The cylinder shall be constructed of steel pipe of sufficient thickness and suitable safety margin. The top of the cylinder shall be equipped with a cylinder head with an internal guide ring and self-adjusting packing.
 - 2. The plunger shall be constructed of a steel shaft of proper diameter machined true and smooth. The plunger shall be provided with a stop electrically welded to the bottom to prevent the plunger from leaving the cylinder.
- T. Roller Chains: Two No.50 roller chains with 5/8 inch (16 mm) pitch. Minimum breaking strength 6100 lb (2773 kg) each.
- U. Leveling Device:
 - 1. The lift shall be provided with an anti-creep device which will maintain the carriage level within 1/2 inch (12 mm) of each landing.
 - 2. All limit switch and leveling device switches shall be located in a position to be inaccessible to unauthorized persons. They shall be located behind the mast wall and be accessible through removable panels.
- V. Guide Yoke: The 2:1 guide yoke/sprocket assembly shall be supplied with idler sheaves, roller guide shoes, bearings and guards.
- W. Terminal Stopping Devices: Normal terminal stopping devices shall be provided at top and bottom of runway to stop the car positively and automatically.
- X. Guide Rails and Brackets: Steel 'C' guide rails and brackets shall be used to guide the platform and sling. Guide rails shall form part of the structural integrity of the unit and be

integral to the mast enclosure, ensuring stability and minimum platform deflection when loaded.

- Y. Car Sling: Car sling shall be fabricated from steel tubing 44 inches (1116 mm) high with adequate bracing to support the platform and car enclosure. Roller guide shoes shall be mounted on the top and bottom of the car sling to engage the guide rails. Guide shoes shall be roller type with 3 inches (76 mm) diameter wheels. Nylon guide shoes shall not be used for better ride quality and durability.
- Z. Wiring: All wiring and electrical connections shall comply with applicable codes. Insulated wiring shall have flame-retardant and moisture-proof outer covering and shall be run in conduit or electrical wire ways if located outside the unit enclosure. Quick disconnect harnesses shall be used when possible.

2.3 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Tubing: ASTM A 500/A 500M.
- C. Steel Pipe: ASTM A 53/A 53M; standard weight (Schedule 40) unless otherwise indicated or required by loads.
- D. Steel Sheet: ASTM A 1008/A 1008M, cold-rolled commercial steel (CS) or ASTM A 1011/A 1011M hot-rolled, commercial steel (CS); as required for each use.
- E. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 (Z275) zinc coating,
- F. Galvanizing: Hot-dip galvanize items complying with the following:
 - 1. ASTM A 123/A 123M, for galvanizing steel and iron products.
 - 2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.
- G. 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.
- H. Expansion Anchors: Anchor-bolt-and-sleeve assembly of material indicated below with capability to sustain a load equal to 10 times the load imposed as determined by testing according to ASTM E 488 conducted by a qualified independent testing agency.
 - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
- I. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M.

2.4 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.

2.5 FINISHES

- A. Steel and Galvanized-Steel Factory Finish:
 - 1. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils (0.05 mm).
 - 2. Color and Gloss: As selected by Architect from manufacturer's full 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 (2032 mm) 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. 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 train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
- C. Coordinate runway doors with platform travel and positioning, for accurate alignment and minimum clearance between platforms, runway doors, sills, and door frames.
- D. Position sills accurately and fill space under sills solidly with nonshrink, nonmetallic grout.
- E. Coordinate platform doors with platform travel and positioning.
- F. Adjust stops for accurate stopping at each landing, within required tolerances.
 - 1. Leveling Tolerance: 1/4 inch (6 mm) up or down, regardless of load and direction of travel.

- G. Lubricate operating parts of lift, including drive mechanism, guide rails, hinges, safety devices, and hardware.
- H. 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 Final Acceptance, maintenance service shall include three 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 Final Acceptance. 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 210050 – BASIC METHODS AND MATERIALS FOR FIRE SUPPRESSION 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. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Sleeves.
 - 3. Escutcheons.
 - 4. Grout.
 - 5. Supports and anchorages.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 SUBMITTALS

- A. Welding certificates.
- B. Hydraulic calculations and piping layout.

1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Coordination. Division 21 and 26 shall coordinate the requirement for providing, installing, and testing of flow and tamper switches.
- D. System design and installation shall fully comply with SCO guidelines including 10psi safety factor in static and residual pressures and 10% reduction in flow.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- E. Welding Filler Metals: Comply with AWS D10.12.

2.3 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.

2.4 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.

2.5 GROUT

- A. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, non-staining, non-corrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.6 WIRING METHODS

- A. Where electrical wiring is required by this trade other than covered by Division 26, the contractor shall refer to the same wiring materials and methods as specified under Division 26. No Exceptions.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- D. Install piping to permit valve servicing.
- E. Install piping free of sags and bends.
- F. Install fittings for changes in direction and branch connections.
- G. Select system components with pressure rating equal to or greater than system operating pressure.
- H. Install escutcheons for penetrations of walls, ceilings, and floors.

- I. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- J. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- K. Verify final equipment locations for roughing-in.
- L. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- F. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.
- B. Field Welding: Comply with AWS D1.1.

END OF SECTION 210050

SECTION 210100 - FIRE-SUPPRESSION 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. This Section includes the following fire-suppression piping inside the building:
 - 1. Wet-pipe sprinkler systems.
- B. See Division 28 Section "Digital Addressable Fire Alarm Systems" for alarm devices not specified in this Section.

1.3 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.4 PERFORMANCE REQUIREMENTS

- A. Standard Piping System Component Working Pressure: Listed for at least 175 psig (1200 kPa).
- B. Fire-suppression sprinkler system design shall comply with procedures outlined in 2014 SCO guidelines for shop drawing approval. The sprinkler contractor must submit "working plans" and hydraulic calculations to Sigma Engineered Solutions for review, prior to any fabrication or installation work. After their review, Sigma Engineered Solutions will forward the shop drawings, hydraulic calculations and material submittals to North Carolina Department of Administration, State Construction Office for their review and comments. No fabrication and or installation shall begin without approved submittals from Sigma Engineered Solutions and the North Carolina Department of Administration, State Construction Office.
- C. Margin of Safety for Available Water Flow and Pressure: 10 percent flow and 10 psi for residual and static pressure, including losses through water-service piping, valves, and backflow preventers.
 - 1. Sprinkler Occupancy Hazard Classifications:
 - a. Building Service Areas: Ordinary Hazard, Group 1.
 - b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.

- c. Dorm rooms: Light Hazard.
 - d. Lounge areas: Light Hazard.
 - e. Office and Public Areas: Light Hazard.
- 2. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Light Hazard Occupancy: 0.10 gpm/sq.ft., over 1500 sq. ft. (6.1 over L/min. per sq. m over 139sq.m or 6.1 mm/min. over 139 sq. m).
- 3. Maximum Protection Area per Sprinkler:
 - a. Office Spaces and meeting: 225 sq. ft. (11.1 sq. m).
 - b. Exercise Areas: 225 sq. ft. (12.1 sq. m).
 - c. Mechanical Equipment Rooms: 130 sq. ft. (12.1 sq. m)
 - d. Electrical Equipment Rooms: 130 sq. ft. (12.1 sq. m)
 - e. Other Areas: According to NFPA 13 recommendations, unless otherwise indicated.
- 4. Total Combined Hose-Stream Demand Requirement: According to NFPA 13, unless otherwise indicated:
 - a. Light-Hazard Occupancies: 100 GPM (15.75 L/s) for 60 to 90 minutes.

1.5 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Field test reports and certificates.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - 1. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
- B. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:
 - 1. NFPA 13, "Installation of Sprinkler Systems."
 - 2. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 STEEL PIPE AND FITTINGS

- A. Threaded-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, with factory- or field-formed threaded ends.
 - 1. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.
 - 2. Steel Threaded Couplings: ASTM A 865.
- B. Grooved-End, Schedule 10 Steel Pipe: ASTM A 135 or ASTM A 795, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10 with factory- or field-formed, roll-grooved ends.
 - 1. Grooved-Joint Piping Systems:
 - a. Manufacturers:
 - 1) Anvil International, Inc.
 - 2) Central Sprinkler Corp.
 - 3) Ductilic, Inc.
 - 4) JDH Pacific, Inc.
 - 5) National Fittings, Inc.
 - 6) Shurjoint Piping Products, Inc.
 - 7) Southwestern Pipe, Inc.
 - 8) Star Pipe Products; Star Fittings Div.
 - 9) Victaulic Co. of America.
 - 10) Ward Manufacturing.
 - b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
 - c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, rubber gasket listed for use with housing, and steel bolts and nuts.
- C. Flexible connectors will not be permitted.

2.3 CPVC PIPE AND FITTINGS

- A. CPVC Pipe: ASTM F 442/F 442M and UL 1821, SDR 13.5, for 175-psig rated pressure at 150 deg F, with plain ends. Include "Listed" and "CPVC Sprinkler Pipe" markings.
 - 1. CPVC Fittings: UL-listed, for 175-psig rated pressure at 150 deg F, socket type. Include "Listed" and "CPVC Sprinkler Fitting" markings.
 - a. NPS 3/4 to NPS 1-1/2: ASTM F 438 and UL 1821, Schedule 40.
 - b. NPS 2 to NPS 3: ASTM F 439 and UL 1821, Schedule 80.
 - 2. Adhesive: ASTM F 493, solvent cement recommended by pipe and fitting manufacturer and made for joining CPVC sprinkler pipe and fittings. Include cleaner or primer recommended by manufacturer of pipe and fittings.

2.4 SPRINKLER SPECIALTY FITTINGS

- A. Sprinkler specialty fittings shall be UL listed or FMG approved, with 175-psig (1200-kPa) minimum working-pressure rating, and made of materials compatible with piping.
- B. Outlet Specialty Fittings:
 - 1. Manufacturers:
 - a. Anvil International, Inc.
 - b. Central Sprinkler Corp.
 - c. Ductilic, Inc.
 - d. JDH Pacific, Inc.
 - e. National Fittings, Inc.
 - f. Shurjoint Piping Products, Inc.
 - g. Southwestern Pipe, Inc.
 - h. Star Pipe Products; Star Fittings Div.
 - i. Victaulic Co. of America.
 - j. Ward Manufacturing.
- C. Sprinkler Drain and Alarm Test Fittings: Cast- or ductile-iron body; with threaded or locking-lug inlet and outlet, test valve, and orifice and sight glass.
 - 1. Manufacturers:
 - a. Central Sprinkler Corp.
 - b. Fire-End and Croker Corp.
 - c. Viking Corp.
 - d. Victaulic Co. of America.

- D. Sprinkler Branch-Line Test Fittings: Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler.
 - 1. Manufacturers:
 - a. Elkhart Brass Mfg. Co., Inc.
 - b. Fire-End and Croker Corp.
 - c. Potter-Roemer; Fire-Protection Div.
- E. Sprinkler Inspector's Test Fitting: Cast- or ductile-iron housing with threaded inlet and drain outlet and sight glass.
 - 1. Manufacturers:
 - a. AGF Manufacturing Co.
 - b. Central Sprinkler Corp.
 - c. G/J Innovations, Inc.
 - d. Triple R Specialty of Ajax, Inc.
- F. Drop-Nipple Fittings: UL 1474, adjustable with threaded inlet and outlet, and seals.
 - 1. Manufacturers:
 - a. CECA, LLC.
 - b. Merit.
 - c. Fire-End and Croker Corp.

2.5 LISTED FIRE-PROTECTION VALVES

- A. Valves shall be UL listed or FMG approved, with 175-psig (1200 kPa) minimum pressure rating.
- B. Butterfly Valves: UL 1091.
 - 1. NPS 2 (DN 50) and Smaller: Bronze body with threaded ends.
 - a. Manufacturers:
 - 1) Global Safety Products, Inc.
 - 2) Milwaukee Valve Company.
 - 3) Victaulic Co. of America.
 - 2. NPS 2-1/2 (DN 65) and Larger: Bronze, cast-iron, or ductile-iron body; wafer type or with grooved ends.
 - a. Manufacturers:
 - 1) Central Sprinkler Corp.
 - 2) Global Safety Products, Inc.
 - 3) McWane, Inc.; Kennedy Valve Div.

- 4) Mueller Company.
- 5) NIBCO.
- 6) Pratt, Henry Company.
- 7) Victaulic Co. of America.

C. Check Valves NPS 2 (DN 50) and Larger: UL 312, swing type, cast-iron body with flanged or grooved ends.

1. Manufacturers:

- a. AFAC Inc.
- b. American Cast Iron Pipe Co.; Waterous Co.
- c. Central Sprinkler Corp.
- d. Clow Valve Co.
- e. Crane Co.; Crane Valve Group; Crane Valves.
- f. Crane Co.; Crane Valve Group; Jenkins Valves.
- g. Firematic Sprinkler Devices, Inc.
- h. Globe Fire Sprinkler Corporation.
- i. Grinnell Fire Protection.
- j. Hammond Valve.
- k. Matco-Norca, Inc.
- l. McWane, Inc.; Kennedy Valve Div.
- m. Mueller Company.
- n. NIBCO.
- o. Potter-Roemer; Fire Protection Div.
- p. Reliable Automatic Sprinkler Co., Inc.
- q. Star Sprinkler Inc.
- r. Stockham.
- s. United Brass Works, Inc.
- t. Venus Fire Protection, Ltd.
- u. Victaulic Co. of America.
- v. Watts Industries, Inc.; Water Products Div.

D. Gate Valves: UL 262, OS&Y type.

1. NPS 2 (DN 50) and Smaller: Bronze body with threaded ends.

a. Manufacturers:

- 1) Crane Co.; Crane Valve Group; Crane Valves.
- 2) Hammond Valve.
- 3) NIBCO.
- 4) United Brass Works, Inc.

2. NPS 2-1/2 (DN 65) and Larger: Cast-iron body with flanged ends.

a. Manufacturers:

- 1) Clow Valve Co.

- 2) Crane Co.; Crane Valve Group; Crane Valves.
- 3) Crane Co.; Crane Valve Group; Jenkins Valves.
- 4) Hammond Valve.
- 5) Milwaukee Valve Company.
- 6) Mueller Company.
- 7) NIBCO.
- 8) Red-White Valve Corp.
- 9) United Brass Works, Inc.

E. Indicating Valves: UL 1091, with integral indicating device and ends matching connecting piping.

1. Indicator: Electrical, 115-V ac, prewired, 2-circuit, supervisory switch.
2. NPS 2 (DN 50) and Smaller: Ball or butterfly valve with bronze body and threaded ends.

a. Manufacturers:

- 1) Milwaukee Valve Company.
- 2) NIBCO.
- 3) Victaulic Co. of America.

3. NPS 2-1/2 (DN 65) and Larger: Butterfly valve with cast- or ductile-iron body; wafer type or with flanged or grooved ends.

a. Manufacturers:

- 1) Central Sprinkler Corp.
- 2) Grinnell Fire Protection.
- 3) McWane, Inc.; Kennedy Valve Div.
- 4) Milwaukee Valve Company.
- 5) NIBCO.
- 6) Victaulic Co. of America.

2.6 UNLISTED GENERAL-DUTY VALVES

- A. Check Valves NPS 2 (DN 50) and Smaller: MSS SP-80, Type 4, Class 125 minimum, swing type with bronze body, nonmetallic disc, and threaded ends.
- B. Gate Valves NPS 2 (DN 50) and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, solid wedge, and threaded ends.
- C. Globe Valves NPS 2 (DN 50) and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, nonmetallic disc, and threaded ends.

2.7 SPECIALTY VALVES

- A. Sprinkler System Control Valves: UL listed or FMG approved, cast- or ductile-iron body with flanged or grooved ends, and 175-psig (1200-kPa) minimum pressure rating.
 - 1. Manufacturers:
 - a. AFAC Inc.
 - b. Central Sprinkler Corp.
 - c. Firematic Sprinkler Devices, Inc.
 - d. Globe Fire Sprinkler Corporation.
 - e. Grinnell Fire Protection.
 - f. Reliable Automatic Sprinkler Co., Inc.
 - g. Star Sprinkler Inc.
 - h. Venus Fire Protection, Ltd.
 - i. Victaulic Co. of America.
 - j. Viking Corp.
- B. Automatic Drain Valves: UL 1726, NPS 3/4 (DN 20), ball-check device with threaded ends.
- C. Alarm Check Valves: UL 193, designed for horizontal or vertical installation, with bronze grooved seat with O-ring seals, single-hinge pin, and latch design. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
 - a. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
 - b. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

2.8 SPRINKLERS

- A. Sprinklers shall be UL listed or FMG approved, with 175-psig (1200-kPa) minimum pressure rating.
- B. Manufacturers:
 - 1. AFAC Inc.
 - 2. Central Sprinkler Corp.
 - 3. Firematic Sprinkler Devices, Inc.
 - 4. Globe Fire Sprinkler Corporation.
 - 5. Grinnell Fire Protection.
 - 6. Reliable Automatic Sprinkler Co., Inc.
 - 7. Star Sprinkler Inc.
 - 8. Venus Fire Protection, Ltd.
 - 9. Victaulic Co. of America.
 - 10. Viking Corp.

- C. Automatic Sprinklers: With heat-responsive element complying with the following:
 - 1. UL 1767, for early-suppression, fast-response applications.
- D. Sprinkler Types and Categories: Nominal 1/2-inch (12.7-mm) orifice for "Ordinary" temperature classification rating, unless otherwise indicated or required by application.
- E. Sprinkler types, features, and options as follows: sprinkler heads installed in rooms with existing heads shall match the same response rating.
 - 1. Concealed ceiling sprinklers, including cover plate, where indicated.
 - 2. Quick-response pendent sprinklers.
 - 3. Quick-response extended coverage pendent sprinklers.
 - 4. Quick-response dry sidewall sprinklers.
 - 5. Quick-response sidewall sprinklers.
 - 6. Quick-response upright sprinklers.
- F. Sprinkler Finishes: Chrome plated, bronze, and factory painted.
- G. Special Coatings: Wax.
- H. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
 - 1. Ceiling Mounting: Chrome-plated steel, 1 piece, with 1-inch (25-mm) vertical adjustment.
- I. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

2.9 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Water-Flow Indicator: UL 346, electrical-supervision, paddle-operated-type, water-flow detector with 250-psig (1725-kPa) pressure rating and designed for horizontal or vertical installation. Include two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
 - 1. Manufacturers:
 - a. ADT Security Services, Inc.
 - b. Grinnell Fire Protection.
 - c. ITT McDonnell & Miller
 - d. Potter Electric Signal Company.
 - e. System Sensor.

- f. Viking Corp.
 - g. Watts Industries, Inc.; Water Products Div.
- C. Valve Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled valve is in other than fully open position.
 - 1. Manufacturers:
 - a. McWane, Inc.; Kennedy Valve Div.
 - b. Potter Electric Signal Company.
 - c. System Sensor.
- D. Pressure Switch: UL 753, electrical-supervision-type, water-flow switch with retard feature. Include single-pole, double-throw, normally closed contacts and design that operates on rising pressure and signals water flow.
 - 1. Manufacturers:
 - a. Grinnell Fire Protection.
 - b. Potter Electric Signal Company.
 - c. System Sensor.
 - d. Viking Corp.
- E. Electrically Operated Alarm: UL 464, with 10-inch- (250-mm-) diameter, vibrating-type, metal alarm bell with red-enamel factory finish and suitable for outdoor use.
 - 1. Manufacturers:
 - a. Potter Electric Signal Company.
 - b. System Sensor.
 - c. Grinnell Fire Protection.

2.10 PRESSURE GAGES

- A. Manufacturers:
 - 1. AGF Manufacturing Co.
 - 2. AMETEK, Inc.; U.S. Gauge.
 - 3. Brecco Corporation.
 - 4. Dresser Equipment Group; Instrument Div.
 - 5. Marsh Bellofram.
 - 6. WIKA Instrument Corporation.
- B. Description: UL 393, 3-1/2- to 4-1/2-inch (90- to 115-mm-) diameter, dial pressure gage with range of 0 to 250 psig (0 to 1725 kPa) minimum.
 - 1. Water System Piping: Include caption "WATER" on dial face.

2.11 Sprinkler Cabinets:

- A. Finished steel cabinet and hinged cover, with space for minimum of 6 spare sprinklers plus sprinkler wrench, suitable for wall mounting. Include number of sprinklers required by NFPA 13 and 1 wrench for sprinklers. Include separate cabinet with sprinklers and wrench for each style sprinkler on project.

2.12 FIRE DEPARTMENT CONNECTIONS

- A. Wall-Type, Fire Department Connection: UL 405, 175-psig minimum pressure rating; with corrosion-resistant-metal body with brass inlets, brass wall escutcheon plate, brass lugged caps with gaskets and brass chains, and brass lugged swivel connections. Include inlets with threads according to NFPA 1963 and matching local fire department sizes and threads, outlet with pipe threads, extension pipe nipples, check devices or clappers for inlets, and escutcheon plate with marking similar to "AUTO SPKR & STANDPIPE."

- 1. Type: Exposed, projecting, with two inlets and round escutcheon plate.
- 2. Finish: Polished brass.

2.13 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers with DA

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Watts Industries, Inc.; Water Products Div.
 - f. Zurn Plumbing Products Group; Wilkins Div.
- 2. Standard: ASSE 1013.
- 3. Operation: Continuous-pressure applications.
- 4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
- 5. Size: see drawings
- 6. Body: Bronze for NPS 2 and smaller
- 7. End Connections: Threaded for NPS 2 and smaller
- 8. Configuration: Designed for horizontal, straight through flow.
- 9. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller;
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS, GENERAL

- A. Flanges, flanged fittings, unions, nipples, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.

3.2 SPRINKLER SYSTEM PIPING APPLICATIONS

- A. NPS 2 (DN 50) and Smaller:
 - 1. Threaded-end, schedule 40, standard-weight steel pipe; cast- or malleable-iron threaded fittings; and threaded joints. Or CPVC with glued fittings.
 - 2. Schedule 40 CPVC
- B. NPS 2½" and Larger: Grooved-end, black schedule 10 steel pipe; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

3.3 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Listed Fire-Protection Valves: UL listed and FMG approved for applications where required by NFPA 13 and NFPA 14.
 - a. Shutoff Duty: Use butterfly or gate valves.
 - 2. Unlisted General-Duty Valves: For applications where UL-listed and FMG-approved valves are not required by NFPA 13 and NFPA 14.
 - a. Shutoff Duty: Use butterfly or gate valves.
 - b. Throttling Duty: Use globe valves.

3.4 JOINT CONSTRUCTION

- A. Refer to Division 21 Section "Basic Methods and Materials for Fire Suppression Systems" for basic piping joint construction.
- B. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe smaller than NPS 8 (DN 200) with wall thickness less than Schedule 40 unless approved by authorities having jurisdiction and threads are checked by a ring gage and comply with ASME B1.20.1.
- C. Grooved Joints: Assemble joints with listed coupling and gasket, lubricant, and bolts.
 - 1. Steel Pipe: Square-cut or roll-groove piping as indicated. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.

3.5 PIPING INSTALLATION

- A. Refer to Division 21 Section "Basic Methods and Materials for Fire Suppression Systems" for basic piping installation.
- B. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- C. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.
- E. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger connections.
- F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13.
- G. Install sprinkler piping with drains for complete system drainage.
- H. Install sprinkler zone control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- I. Install drain valves on standpipes.
- J. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.
- K. Install alarm devices in piping systems.
- L. Hangers and Supports: Comply with NFPA 13 for hanger materials.
 - 1. Install sprinkler system piping according to NFPA 13.
- M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 (DN 8) and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
- N. Fill wet-pipe sprinkler system piping with water, flush and refill

3.6 VALVE INSTALLATION

- A. Install listed fire-protection valves, unlisted general-duty valves, specialty valves and trim, controls, and specialties according to NFPA 13 and NFPA 14 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections. Install permanent identification signs indicating portion of system controlled by each valve. Denote location on grid, if any operable devices are located above the ceiling.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water supply sources.

3.7 SPRINKLER APPLICATIONS

- A. Drawings indicate sprinkler types to be used. Where specific types are not indicated, use the following sprinkler types:
 - 1. Rooms without Ceilings: Upright sprinklers with wire guard where indicated.
 - 2. Rooms with Suspended Ceilings: Pendent, recessed, flush, and concealed sprinklers, as indicated.
 - 3. Wall Mounting: Sidewall sprinklers.
 - 4. Spaces Subject to Freezing: Upright, pendent, dry sprinklers; and sidewall, dry sprinklers as indicated
 - 5. Sprinkler Finishes:
 - a. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.
 - b. Concealed Sprinklers: Smooth brass, with factory-painted white cover plate.
 - c. Flush Sprinklers: Bright chrome, with painted white escutcheon.
 - d. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.

3.8 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels and tiles.
- B. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space.
- C. Install manual air vents at high points in the sprinkler piping.

3.9 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Connect water-supply piping to fire-suppression piping.
- D. Connect piping to specialty valves, hose valves, specialties, and accessories.
- E. Electrical Connections: Power wiring is specified in Division 26.
- F. Connect alarm devices to fire alarm.
- G. Ground equipment according to Division 26 Section "Grounding and Bonding."
- H. Connect wiring according to Division 26 Section "Power Conductors and Cables."

3.10 LABELING AND IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

3.11 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 - 3. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
 - 4. Coordinate with fire alarm tests. Operate as required.
- B. Prior to making request for Beneficial Occupancy, the contractor shall submit written test reports and certificates as required by NFPA 13 and 24. Submittals shall include acceptance form approved by NFPA only, no other forms shall be considered.

END OF SECTION 210100

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SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

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. Piping materials and installation instructions common to most piping systems.
 - 2. Dielectric fittings.
 - 3. Escutcheons.
 - 4. Grout.
 - 5. Equipment installation requirements common to equipment sections.
 - 6. Concrete bases.
 - 7. Supports and anchorages.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than plumbing and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and plumbing equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 SUBMITTALS

- A. Plumbing Piping
- B. Plumbing Fixtures & Equipment
- C. Plumbing Insulation

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

2.3 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Not accepted.
- D. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
- E. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

2.4 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.

2.5 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.
- C. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.

2.6 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.7 WIRING METHODS

- A. Where electrical wiring is required by this trade other than covered by Division 26, the contractor shall refer to the same wiring materials and methods as specified under Division 26. No Exceptions.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install

piping as indicated unless deviations to layout are approved on Coordination Drawings.

- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install escutcheons for penetrations of walls, ceilings, and floors.
- L. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- M. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- N. Verify final equipment locations for roughing-in.
- O. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.5 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

3.7 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 220500

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

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. Warning signs and labels.
 - 2. Pipe labels.

1.3 SUBMITTAL

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

PART 2 - PRODUCTS

2.1 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pre-tensioned Pipe Labels: Pre-coiled, semi-rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.2 EQUIPMENT LABELLING

- A. Equipment Markers: Engraved phenolic plates white background and black lettering securely fastened to the equipment with sheet metal screws.
 - 1. Terminology: Match schedules as closely as possible.

2. Data:
 - a. Name and plan number.
 - b. Date of Installation.
 - c. Design capacity.
3. Size: 4-1/2 by 6 inches (115 by 150 mm) for equipment.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of plumbing equipment such as water heaters and pumps.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 1. Near each valve and control device.
 2. Affixed to ceiling grid where valves are located above hard or acoustical ceilings.
 3. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 4. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 5. At access doors, manholes, and similar access points that permit view of concealed piping.
 6. Near major equipment items and other points of origination and termination.
 7. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
 8. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Pipe Label Color Schedule (Label Designation):
 1. Domestic Hot Water (DHW) Piping and Domestic Hot Water Return (DHW):

Background Color: Dark Yellow (Gold)
Letter Color: Black.

2. Domestic Cold Water (DCW) Piping:

Background Color: Dark Green
Letter Color: Black.

END OF SECTION 220553

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SECTION 220700 - PLUMBING 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. Insulation Materials:
 - a. Cellular glass.
 - b. Mineral fiber.
 - c. Polyolefin.
 - 2. Insulating cements.
 - 3. Adhesives.
 - 4. Mastics.
 - 5. Sealants.
 - 6. Factory-applied jackets.
 - 7. Field-applied fabric-reinforcing mesh.
 - 8. Field-applied jackets.
 - 9. Tapes.
 - 10. Securements.
 - 11. Corner angles.
- B. Related Sections include the following:
 - 1. Division 23 Section "HVAC Insulation."

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 3. Detail removable insulation at piping specialties, equipment connections, and access panels.
 - 4. Detail application of field-applied jackets.

- C. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Interior and Exterior: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. 1½" Fiberglass with paper jacket on DHW and DCW metal pipes 1¼" and larger.
- B. Pex tubing (sizes 1" and smaller) shall be uninsulated.
- C. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- D. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- E. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- F. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- G. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000 Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
 - 2. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

- H. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Armacell LLC; Tubolit.
 - b. Nomaco Inc.; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.
 - c. RBX Corporation; Therma-cell.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Insulco, Division of MFS, Inc.; SmoothKote.
 - b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
 - c. Rock Wool Manufacturing Company; Delta One Shot.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

- B. Cellular-Glass Polystyrene Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F (minus 59 to plus 149 deg C).

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-96.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-33.

- C. Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA Inc.; Aeroseal.
 - b. Armacell LCC; 520 Adhesive.
 - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
 - d. RBX Corporation; Rubatex Contact Adhesive.

- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
- E. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

2.5 SEALANTS

- A. Joint Sealants:
 - 1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-45.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
 - f. Vimasco Corporation; 750.
 - 2. Joint Sealants for Polystyrene Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-70.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-45/30-46.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.

- e. Vimasco Corporation; 750.
 - 3. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 4. Permanently flexible, elastomeric sealant.
 - 5. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
 - 6. Color: White or gray.
- B. FSK and Metal Jacket Flashing Sealants:
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76-8.
 - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
 - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 3. Fire- and water-resistant, flexible, elastomeric sealant.
 - 4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
 - 5. Color: Aluminum.
- C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76.
 - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 3. Fire- and water-resistant, flexible, elastomeric sealant.
 - 4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
 - 5. Color: White.

2.6 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
- 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 - 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 - 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

4. PVDC Jacket for Indoor Applications: 4-mil- (0.10-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms (0.013 metric perms) when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
5. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.7 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches (75 mm).
 3. Thickness: 11.5 mils (0.29 mm).
 4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - b. Compac Corp.; 120.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
 - d. Venture Tape; 3520 CW.

2. Width: 2 inches (50 mm).
3. Thickness: 3.7 mils (0.093 mm).
4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

C. PVDC Tape: White vapor-retarder PVDC tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.
2. Width: 3 inches (75 mm).
3. Film Thickness: 6 mils (0.15 mm).
4. Adhesive Thickness: 1.5 mils (0.04 mm).
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch (10.1 N/mm) in width.

2.8 SECUREMENTS

A. Aluminum Bands: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) wing or closed seal.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products; Bands.
 - b. PABCO Metals Corporation; Bands.
 - c. RPR Products, Inc.; Bands.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

C. Wire: 0.080-inch (2.0-mm) nickel-copper alloy.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. C & F Wire.
 - b. Childers Products.
 - c. PABCO Metals Corporation.
 - d. RPR Products, Inc.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches (100 mm) o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.

3.3 PENETRATIONS

- A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Division 07 Section "Penetration Firestopping" firestopping and fire-resistive joint sealers.
- C. Insulation Installation at Floor Penetrations:
 - 1. Pipe: Install insulation continuously through floor penetrations.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.4 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and

- irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

C. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.6 POLYOLEFIN INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 FINISHES

A. Equipment and Pipe Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, two locations of threaded strainers, three locations of threaded valves, for each pipe service defined in the "Piping Insulation Schedule, General" Article.

- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.10 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Hot and Re-circulating Hot Water: Insulation shall be one of the following:
 - 1. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
 - 2. Polyolefin: 1 inch (25 mm) thick.
- B. Domestic Cold Water (Potable): Insulation shall be one of the following:
 - 1. Mineral-Fiber, Preformed Pipe Insulation, Type I: 3/4 inch (19 mm) thick.
 - 2. Polyolefin: 1/2 inch (13 mm) thick.
- C. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities: Insulation shall be one of the following:
 - 1. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
 - 2. Polyolefin: 3/4 inch (19 mm) thick.

3.11 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

END OF SECTION 220700

SECTION 221116 - DOMESTIC WATER PIPING (POTABLE)

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. Specialty valves.
 - 2. Flexible connectors.
 - 3. Escutcheons.
 - 4. Sleeves and sleeve seals.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 61 for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Press fittings will not be accepted.
- B. No galvanized piping or components will be accepted.
- C. DCW piping serving flush valves shall be copper type 'M' piping.
- D. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- E. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
 - 1. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- F. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.
1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

2.2 PIPING JOINING MATERIALS

- A. Brazed joins and fittings for copper piping.
- B. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
- C. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.3 SPECIALTY VALVES

- A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.
- B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.

2.4 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
- B. Dielectric Unions:
1. Description:
 - a. Pressure Rating: 150 psig (1035 kPa) at 180 deg F (82 deg C).
 - b. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Nipples:
1. Description:

- a. Electroplated steel nipple complying with ASTM F 1545.
- b. Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C).
- c. End Connections: Male threaded or grooved.
- d. Lining: Inert and non-corrosive, propylene.

2.5 FLEXIBLE CONNECTORS

- A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 - 1. Working-Pressure Rating: Minimum 200 psig (1380 kPa).
 - 2. End Connections NPS 2 (DN 50) and Smaller: Threaded copper pipe or plain-end copper tube.
 - 3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged copper alloy.
- B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
 - 1. Working-Pressure Rating: Minimum 200 psig (1380 kPa).
 - 2. End Connections NPS 2 (DN 50) and Smaller: Threaded steel-pipe nipple.
 - 3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged steel nipple.

2.6 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. One Piece, Cast Brass: Polished, chrome-plated finish with setscrews.
- C. One Piece, Stamped Steel: Chrome-plated finish with setscrew.
- D. Split Casting, Cast Brass: Polished, chrome-plated finish with concealed hinge and setscrew.

2.7 SLEEVES

- A. Cast-Iron Wall Pipes: Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.
- C. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.

2.8 SLEEVE SEALS

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

2.9 GROUT

- A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Non-shrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.
- D. Install shutoff valve immediately upstream of each dielectric fitting.
- E. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.
- F. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

- G. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- H. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- I. Install piping adjacent to equipment and specialties to allow service and maintenance.
- J. Install piping to permit valve servicing.
- K. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- L. Install piping free of sags and bends.
- M. Install fittings for changes in direction and branch connections.
- N. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

3.2 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- E. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Braze Joints" Chapter.
- F. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.3 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 (DN 50) and smaller. Use butterfly or gate valves for piping NPS 2-1/2 (DN 65) and larger.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
 - 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
- D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 (DN 50) and smaller. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.

3.4 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing. Arrange piping to minimize the occurrences of dielectric fittings.
- B. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric nipples or bronze valves. Dielectric unions will not be accepted.

3.5 FLEXIBLE CONNECTOR INSTALLATION

- A. Install flexible connectors in suction and discharge piping connections to each domestic water pump.
- B. Install bronze-hose flexible connectors in copper domestic water tubing.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
- B. Support vertical piping and tubing at base.

- C. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
 - 3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
 - 4. NPS 3: 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
- D. Install supports for vertical copper tubing every 10 feet (3 m).
- E. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 2. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
 - 3. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 (DN 65) and larger.

3.8 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.
- B. Escutcheons for New Piping:
 - 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 - 2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish with set screw.
 - 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece or split casting, cast brass with polished chrome-plated finish with set screw.
 - 4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with rough-brass finish with set screw.

5. Bare Piping in Equipment Rooms: One piece, cast brass with set screw.
6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.9 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- D. Install sleeves in new partitions, slabs, and walls as they are built.
- E. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- F. Seal space outside of sleeves in concrete slabs and walls with grout.
- G. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- H. Install sleeve materials according to the following applications:
 1. Sleeves for Piping Passing through Concrete Floor Slabs: Steel pipe.
 2. Sleeves for Piping Passing through Gypsum-Board Partitions:
 - a. Steel pipe sleeves for pipes smaller than NPS 6 (DN 150).
 - b. Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
- I. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestop materials and installations.

3.10 SLEEVE SEAL INSTALLATION

- A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
- B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.11 IDENTIFICATION

- A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.
- B. Label pressure piping with system operating pressure.

3.12 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Piping Inspections:
 - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - 2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 - 3. Re-inspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for re-inspection.
 - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- C. Piping Tests:
 - 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - 2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - 3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 4. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, or 100psig whichever is greater, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - 5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
 - 6. Prepare reports for tests and for corrective action required.

- D. Domestic water piping will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.13 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
 - 1. Purge new piping before using.
 - 2. Fill Line: After all prerequisites are met, fill the system slowly with water, at a velocity of approximately 1 foot per second, while necessary measures are taken to eliminate all air at the highest points of the system where air may collect in pockets. After filling, shut off system in order to prevent contaminated water from flowing back in the line supplying the water.
 - 3. Pressure Test: A pressure test shall be performed. Piping shall be tested at 1.5 times working pressure for 24 hrs.
 - 4. Flushing: Allow filled system to set undisturbed for a minimum of 4 hours, then begin flushing operations. The section of main to be disinfected shall be flushed through blow-off assemblies. Flushing shall be a velocity of not less than 2.5 feet per second to remove sediment and other foreign matter until the water runs clear. The Contractor shall be responsible for making adequate provisions for drainage of large volume of flushing water, including proper de-chlorination/disposal of chlorinated water. Any damages that may occur from this operation shall be the sole responsibility of the Contractor. In conjunction with beginning flushing, authorities having jurisdiction representative will perform a high range chlorine concentration test. Chlorine concentration of 50 mg/l minimum must be provided. Allow chlorinated water to set in the test section for 24 hours. The chlorine concentration shall not drop below 20 ppm within a minimum period of 24 hours.
 - 5. Sampling – Day 1: Check chlorine and turbidity. After allowing the system to flush so that at least two volumes of water pass through the main, the first bacteria sample shall be collected at regular intervals not exceeding 1,200 feet, and tested for bacteriological quality. The contractor shall be responsible for making adequate provisions for drainage of large volume of flushing water, including proper de-chlorination/disposal of heavily chlorinated water.
 - 6. Sampling – Day 2: The water main shall not be flushed again. Inspector will check both chlorine concentration and turbidity. If within the acceptable limits, a second bacteriological test will be performed collecting from the same discharge points as on day one. If the second bacteria sample has passed, the system shall be left in service, provided a low range chlorine concentration test has been taken and approved by an NCSU representative. The chlorine concentration shall be less than 2 mg/l or no higher than that generally prevailing in the source system.
 - 7. Certification of bacteriological testing for quality of the domestic water shall be conducted prior of and included in the request for Beneficial Occupancy

3.14 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Under-building-slab, domestic water, building service piping, NPS 3 and smaller, shall be the following:
 - 1. Soft copper tube, ASTM B 88, Type K; wrought-copper solder-joint fittings; and brazed joints.
 - 2. Concrete-lined DIP with integral flanges. "Mega Lug" – type fittings will not be accepted.
- D. Aboveground domestic water piping, NPS 1" and smaller shall be the following: except for flush valves:
 - 1. Hard copper tube, ASTM B 88, Type L wrought- copper solder-joint fittings; and soldered joints.
- E. Aboveground domestic water piping, NPS 1¼" and larger and for all flush valves shall be the following:
 - 1. Hard copper tube, ASTM B 88, Type L wrought- copper solder-joint fittings; and soldered joints.

PART 4 - FINAL

- A. After final flushing, flow all fixtures to confirm the valves are open.

END OF SECTION 221116

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SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

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 domestic water piping specialties:
 - 1. Vacuum breakers.
 - 2. Backflow preventers.
 - 3. Water pressure-reducing valves.
 - 4. Balancing valves.
 - 5. Temperature-actuated water mixing valves.
 - 6. Strainers.
 - 7. Hose bibbs.
 - 8. Wall hydrants.
 - 9. Drain valves.
 - 10. Water hammer arresters.
 - 11. Trap-seal primer valves.
 - 12. Temperature Gages.
- B. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.
- C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. NSF Compliance:
 - 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
 - 2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. FEBCO; SPX Valves & Controls.
 - e. Rain Bird Corporation.
 - f. Toro Company (The); Irrigation Div.
 - g. Watts Industries, Inc.; Water Products Div.
 - h. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3 , as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Chrome plated.

B. Hose-Connection Vacuum Breakers

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arrowhead Brass Products, Inc.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. Legend Valve.
 - e. MIFAB, Inc.
 - f. Prier Products, Inc.
 - g. Watts Industries, Inc.; Water Products Div.
 - h. Woodford Manufacturing Company.
 - i. Zurn Plumbing Products Group; Light Commercial Operation.
 - j. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1001.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated

2.2 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Watts Industries, Inc.; Water Products Div.
 - f. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1013.
3. AHJ: Backflow preventer shall comply with the City of Raleigh Backflow prevention guidelines in materials, and installation.
4. Operation: Continuous-pressure applications.
5. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
6. Size: see drawings
7. Body: Bronze for NPS 2 and smaller
8. End Connections: Threaded for NPS 2 and smaller
9. Configuration: Designed for horizontal, straight through flow.
10. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller;
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

B. Backflow-Preventer Test Kits

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. FEBCO; SPX Valves & Controls.
 - c. Flomatic Corporation.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Zurn Plumbing Products Group; Wilkins Div.
2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.3 WATER PRESSURE-REDUCING VALVES

A. Water Regulators

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cash Acme.
 - b. Conbraco Industries, Inc.
 - c. Honeywell Water Controls.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig
4. Design Inlet Pressure: To be measured by the contractor
5. Design Outlet Pressure Setting: 80 psig
6. Body: Bronze for NPS 2 and smaller

2.4 BALANCING VALVES

A. Memory-Stop Balancing Valves

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Div.
 - e. Hammond Valve.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Red-White Valve Corp.
2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig minimum CWP.
4. Size: NPS 2 or smaller.
5. Body: Copper alloy.
6. Port: full port.
7. Ball: Chrome-plated brass.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

2.5 HOSE BIBBS

A. Hose Bibbs :

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig (860 kPa).
7. Vacuum Breaker: Integral or field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Finished Rooms and pool area: Chrome or nickel plated.
10. Operation for Equipment Rooms: Wheel handle
11. Operation for Finished Rooms: Wheel handle
12. Include operating key with each operating-key hose bibb.
13. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.6 WALL HYDRANTS

1. Nonfreeze Wall Hydrants:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Prier Products, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Woodford Manufacturing Company.
 - h. Zurn Plumbing Products Group; Light Commercial Operation.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
 - j. <Insert manufacturer's name.>
3. Standard: ASME A112.21.3M for concealed -outlet, self-draining wall hydrants.
4. Pressure Rating: 125 psig.
5. Operation: Loose key.
6. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
7. Inlet: NPS 3/4 .
8. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
9. Box: Deep, flush mounting with cover.
10. Box and Cover Finish: Polished nickel bronze.
11. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7..

2.7 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves :

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4 .
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.8 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. PPP Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - g. Tyler Pipe; Wade Div.
 - h. Watts Drainage Products Inc.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.9 TEMPERATURE GAGES

A. Digital temperature gages.:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. PPP Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

- g. Tyler Pipe; Wade Div.
 - h. Watts Drainage Products Inc.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
- 2. Display: Digital, LCD, 1"
- 3. Case: Polycarbonate or Aluminum.
- 4. Power: Solar/Battery
- 5. Power Life: 4000hrs.
- 6. Automatic power off: 1 hour
- 7. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.
- 8. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.
- 9. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 - 1. Locate backflow preventers in same room as connected equipment or system.
 - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 - 3. Do not install bypass piping around backflow preventers.
- C. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.
- D. Install balancing valves in locations where they can easily be adjusted.
- E. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install thermometers and water regulators if specified.
- F. Install water hammer arresters in water piping according to PDI-WH 201.
- G. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- H. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.
- I. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 1. Reduced-pressure-principle backflow preventers.
 2. Double-check backflow-prevention assemblies.
 3. Water pressure-reducing valves.
- J. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
 1. Test each reduced-pressure-principle backflow preventer double-check backflow-prevention assembly according to authorities having jurisdiction and the device's reference standard.
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.3 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 221119

SECTION 221316 - SANITARY WASTE, VENT AND STORM DRAIN PIPING

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 soil and waste, storm drainage and vent piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.

1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.4 SUBMITTALS

- A. Field quality-control inspection and test reports.

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Hub-and-Spigot, Cast-Iron Pipe and Fittings: ASTM A 74, Service class.
 - 1. Gaskets: ASTM C 564, rubber.
- B. Solid-Wall PVC Pipe: ASTM D 2665, solid-wall drain, waste, and vent.
 - 1. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Special pipe fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.
- B. Above ground Waste, Vent piping
 - 1. Schedule 40 PVC.
- C. Roof leader and storm piping shall be
 - 1. Schedule 40 PVC.
- D. Underground, storm drain, soil, waste, and vent piping NPS 5 (DN 125) and smaller shall be the following:
 - 1. Hub and spigot cast iron.

3.2 PIPING INSTALLATION

- A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- C. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Wall penetration systems are specified in Division 22 Section "Common Work Results for Plumbing."
- D. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- E. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

- F. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
 - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- G. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- H. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- I. Do not locate any clean outs above ceilings, clean outs must be brought level to the floor above.

3.3 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

3.4 HANGER AND SUPPORT INSTALLATION

- A. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
- B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
- E. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS

- A. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Sanitary Waste Piping Specialties".
2. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Sanitary Waste Piping Specialties."
3. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.

3.6 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping accordance with North Carolina Plumbing Code.
 1. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 2. Prepare reports for tests and required corrective action.

3.7 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

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 sanitary drainage piping specialties:
 - 1. Cleanouts.
 - 2. Floor drains.
 - 3. Miscellaneous sanitary drainage piping specialties.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for grease interceptors.

1.4 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 CLEANOUTS

- A. Exposed Cast-Iron Cleanouts :
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
 - 3. Size: Same as connected drainage piping

4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Floor Cleanouts ; FCO:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company; Josam Div.
 - b. Oatey.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Light Commercial Operation.
 - h. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M for threaded, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Cast-iron soil pipe with cast-iron ferrule, threaded, adjustable housing.
5. Body or Ferrule: Cast iron
6. Clamping Device: Not required].
7. Outlet Connection: Inside calk.
8. Closure: Brass plug with tapered threads.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round
12. Top Loading Classification: Heavy Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts; (WCO):

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M. Include wall access.

3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, drilled-and-threaded brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains : (Refer to Drawing schedule for drain types):

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Commercial Enameling Co.
 - b. Josam Company; Josam Div.
 - c. MIFAB, Inc.
 - d. Prier Products, Inc.
 - e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - f. Tyler Pipe; Wade Div.
 - g. Watts Drainage Products Inc.
 - h. Zurn Plumbing Products Group; Light Commercial Operation.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Pattern: Floor drain.
3. Body Material: cast iron.
4. Seepage Flange: Required for upper levels.
5. Anchor Flange: Required.
6. Clamping Device: Required.
7. Outlet: Bottom.
8. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant epoxy enamel.
9. Top of Body and Strainer Finish: Nickel bronze and polished bronze.
10. Top Shape: square.

B. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

C. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches (51 mm) above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

2.3 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
 1. General Use: 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness.
 2. Vent Pipe Flashing: 3.0-lb/sq. ft. (15-kg/sq. m), 0.0469-inch (1.2-mm) thickness.
 3. Burning: 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness.
- B. Fasteners: Metal compatible with material and substrate being fastened.
- C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- D. Solder: ASTM B 32, lead-free alloy.
- E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
 2. Locate at each change in direction of piping greater than 45 degrees.
 3. Locate at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
 4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

- D. For cleanouts located in concealed piping, install cleanout wall access covers, with frame and cover flush with finished wall.
- E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - a. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
 - 2. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - 3. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- F. Assemble open drain fittings and install with top of hub 2 inches above floor.
- G. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- H. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- I. Install traps on plumbing specialty drain outlets.
- J. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness or thinner.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches (250 mm), and skirt or flange extending at least 8 inches (200 mm) around pipe.
 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.
- C. Set flashing on floors in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- 3.4 PROTECTION
- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 224000 - PLUMBING FIXTURES

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. Faucets for lavatories and sinks.
 - 2. Fixture supports.
 - 3. Lavatories.
 - 4. Kitchen sinks.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. FRP: Fiberglass-reinforced plastic.
- D. PMMA: Polymethyl methacrylate (acrylic) plastic.
- E. PVC: Polyvinyl chloride plastic.
- F. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and maintenance data.

1.5 QUALITY ASSURANCE

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

- B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
- C. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- E. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- F. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
 - 1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
 - 2. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
 - 3. Vitreous-China Fixtures: ASME A112.19.2M.
 - 4. Water-Closet, Flush Valve,: ASME A112.19.5.
- G. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
 - 1. Faucets: ASME A112.18.1.
 - 2. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 - 3. NSF Potable-Water Materials: NSF 61.
 - 4. Pipe Threads: ASME B1.20.1.
 - 5. Supply Fittings: ASME A112.18.1.
 - 6. Brass Waste Fittings: ASME A112.18.2.
- H. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
 - 1. Atmospheric Vacuum Breakers: ASSE 1001.
 - 2. Brass and Copper Supplies: ASME A112.18.1.
 - 3. Manual-Operation Flushometers: ASSE 1037.
 - 4. Plastic Tubular Fittings: ASTM F 409.
 - 5. Brass Waste Fittings: ASME A112.18.2.
- I. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Flexible Water Connectors: ASME A112.18.6.
 - 2. Grab Bars: ASTM F 446.
 - 3. Hose-Coupling Threads: ASME B1.20.7.
 - 4. Pipe Threads: ASME B1.20.1.
 - 5. Plastic Toilet Seats: ANSI Z124.5.

PART 2 - PRODUCTS

2.1 LAVATORY FAUCETS

A. Lavatory Faucets,

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
 - a. American Standard Companies, Inc.
 - b. Bradley Corporation.
 - c. Chicago Faucets.
 - d. Delta Faucet Company.
 - e. Eljer.
 - f. Elkay Manufacturing Co.
 - g. Kohler Co.
 - h. Moen, Inc.

2.2 SINK FAUCETS

A. Sink Faucets:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
 - a. American Standard Companies, Inc.
 - b. Bradley Corporation.
 - c. Chicago Faucets.
 - d. Delta Faucet Company.
 - e. Eljer.
 - f. Elkay Manufacturing Co.
 - g. Kohler Co.
 - h. Moen, Inc.

2.3 FIXTURE SUPPORTS

A. Manufacturers: Subject to compliance with requirements, use one of the following manufacturers :

1. Josam Company.
2. MIFAB Manufacturing Inc.
3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Lavatory Supports:

1. Description: Type III, lavatory carrier with hanger plate and tie rod for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

2.4 LAVATORIES

A. Lavatories:

1. Manufacturers: Subject to compliance with requirements, use one of the following manufacturers :
 - a. American Standard Companies, Inc.
 - b. Commercial Enameling Company.
 - c. Eljer.
 - d. Kohler Co.

2.5 KITCHEN SINKS

A. Kitchen Sinks

- B. Manufacturers: Subject to compliance with requirements, use one of the following manufacturers :
 - a. Commercial Enameling Company.
 - b. Eljer.
 - c. Kohler Co.
 - d. Elkay

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

- E. Install wall-mounting fixtures with tubular waste piping attached to supports.
- F. Install fixtures level and plumb according to roughing-in drawings.
- G. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
- H. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- I. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- J. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- K. Install toilet seats on water closets.
- L. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- M. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- N. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- O. Install escutcheons at piping wall and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
- P. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- E. Division 22000 shall provide rough-ins and that make final connection to any equipment provided by others such as ice maker, and dish washer.

3.3 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- E. Install fresh batteries in sensor-operated mechanisms.

3.4 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

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. Sleeves.
 - 2. Escutcheons.
 - 3. Equipment installation requirements common to equipment sections.
 - 4. Concrete bases.
 - 5. Supports and anchorages.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 SUBMITTALS

- A. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

- B. Non-Destructive Inspection and Testing: A/E shall visually inspect pipe welds. Based on visual inspections, upon order of the A/E, non-destructive testing of selected pipe welds shall be performed by a qualified testing agency, at the expense of the Owner, using one of the following methods selected by the A/E. The welds inspected shall be selected randomly, but the selection shall include an examination of welds made by each welding operator or welder.
1. Radiographic testing in accordance with ASTM E 94:
 - a. Make identification of defects by comparing radiographs to reference radiographs in ASTM E 390.
 - b. Film shall positively and properly identify as to member being inspected, location of weld, and location of film on weld.
 - c. Stamp identification on steel so film may be easily identified and matched to identification mark
 2. Ultrasonic testing in accordance with ASTM E 164:
 - a. Size of defects will be determined by relating amplitude of oscilloscope traces to hole in ASTM reference weldment.
 - b. Diameter of reference holes shall be 3/32-inch.
 - c. Weld defects which are cause for rejection include cracks, lack of fusion, incomplete penetration, porosity, or slag inclusions which produce reflections equal to or greater than 80 percent of reference hole reflection and have linear dimensions as indicated by transducer movement exceeding 1/4-inch for material thickness up to and including 3/4-inch.
- C. Correction of Defective Welds: If random testing reveals that any welds fail to meet minimum quality requirements, an additional 10 percent of the welds in that same group shall be inspected at the Contractor's expense. If all of the additional welds inspected meet the quality requirements, the entire group of welds represented shall be accepted and the defective welds shall be repaired. If any of the additional welds inspected also fail to meet the quality requirements, that entire group of welds shall be rejected. At the Contractor's option, the rejected welds shall be removed and the joints rewelded or the rejected welds shall be 100 percent tested as hereinbefore specified and all defective weld areas removed and rewelded.
- D. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements. No additional cost will be allowed for such changes and substitutions.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Use type L copper piping for all condensate drain piping

2.2 JOINING MATERIALS

- A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- B. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.

2.3 SLEEVES

- A. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

2.4 ESCUTCHEONS

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

2.5 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.2 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

3.3 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.4 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.5 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 230500

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

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

1.3 COORDINATION

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

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.
- C. Provide with shaft grounding rings

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Premium Efficiency, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Rotor: Random-wound, squirrel cage.
- F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating.
- H. Insulation: Class F Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- I. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multi-speed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
 2. Capacitor start, inductor run.
 3. Capacitor start, capacitor run.
- B. Multispeed Motors: Electronically Commutated (ECM).
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

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SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING

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. Bronze ball valves.
 - 2. Iron, single-flange butterfly valves.
 - 3. Wafer disc check valves.
 - 4. Iron gate valves.
- B. Related Sections:
 - 1. Division 23 HVAC piping Sections for specialty valves applicable to those Sections only.
 - 2. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.3 SUBMITTALS

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

1.4 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to HVAC valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 8 (DN 200) and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 (DN 150) and smaller.
4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

E. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions and the following features:

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

F. Valve-End Connections:

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

2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: :
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Hammond Valve.
 - d. Lance Valves; a division of Advanced Thermal Systems, Inc.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig (1035 kPa).
 - c. CWP Rating: 600 psig (4140 kPa).
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Full.

2.3 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Manufacturers:

- a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
- b. Conbraco Industries, Inc.; Apollo Valves.
- c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
- d. Crane Co.; Crane Valve Group; Jenkins Valves.
- e. Crane Co.; Crane Valve Group; Stockham Division.
- f. DeZurik Water Controls.
- g. Flo Fab Inc.
- h. Hammond Valve.
- i. Kitz Corporation.
- j. Legend Valve.
- k. Milwaukee Valve Company.
- l. NIBCO INC.
- m. Norriseal; a Dover Corporation company.
- n. Red-White Valve Corporation.
- o. Spence Strainers International; a division of CIRCOR International.
- p. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Aluminum bronze.

2.4 WAFER DISC CHECK VALVES

A. Class 150, Wafer Disc Check Valves with Soft Seal Metal Seats, non slam, spring assisted:

1. Manufacturers:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.
- d. Hammond Valve.
- e. Milwaukee Valve Company.
- f. NIBCO INC.
- g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: AWWA C518.
- b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 500 psig (3450 kPa).
- c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 300 psig (2070 kPa).
- d. Body Design: Clear or full waterway.
- e. Body Material: ASTM A 126, gray iron with bolted bonnet.
- f. Ends: Flanged.
- g. Trim: Bronze.
- h. Gasket: Asbestos free.

2.5 IRON GATE VALVES

A. Class 150, OS&Y, Iron Gate Valves:

1. Manufacturers:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Stockham Division.
- c. Hammond Valve.
- d. Milwaukee Valve Company.
- e. NIBCO INC.
- f. Powell Valves.
- g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-70, Type I.
- b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 500 psig (3450 kPa).
- c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 300 psig (2070 kPa).
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Ends: Flanged.
- f. Trim: Bronze.
- g. Disc: Solid wedge.
- h. Packing and Gasket: Asbestos free.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.

- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install swing check valves for proper direction of flow and in horizontal position with hinge pin level.
- F. Valves installed over 8' A.F.F shall have chain wheels fitted to allow operation from floor level.

3.3 ADJUSTING

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

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service (In Ground): Gate valves.
 - 2. Shutoff Service (Above Ground): Butterfly or Ball valves.
 - 3. Pump-Discharge Check Valves:
 - a. Wafer disk check valves with lever and weight or with spring.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
 - 2. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends.
 - 3. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.

3.5 CHILLED-WATER VALVE SCHEDULE

- A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, full port, bronze stainless-steel trim.
3. Bronze Swing Check Valves: Class 150, bronze disc.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged.
2. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 200 CWP, EPDM seat, aluminum-bronze disc.
3. Iron Swing Check Valves: Class 250, nonmetallic-to-metal seats.
4. Iron Gate Valves: Class 150 OS&Y.

END OF SECTION 230523

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

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. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Fastener systems.
 - 5. Equipment supports.
- B. See Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
- C. See Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-protection piping.
- D. See Section "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

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

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Retain a registered engineer to design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.

2. Powder-actuated fastener systems.
3. Shop Drawings: Signed and sealed by a qualified professional engineer showing seismic-restraint hangers and supports for piping and equipment

- B. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 EQUIPMENT SUPPORTS

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

2.3 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

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

3.5 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 230529

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SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

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 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. This Section includes the following mechanical identification materials and their installation:

1. Equipment nameplates.
2. Equipment markers.
3. Equipment signs.
4. Access panel and door markers.
5. Pipe markers.
6. Stencils.
7. Valve tags.
8. Valve schedules.
9. Warning tags.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.6 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with location of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION DEVICES

- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
 - 1. Data:
 - a. Manufacturer, product name, model number, and serial number.
 - b. Capacity, operating and power characteristics, and essential data.
 - c. Labels of tested compliances.
 - 2. Location: Accessible and visible.
 - 3. Fasteners: As required to mount on equipment.
- B. Equipment Markers: Engraved phenolic plates white background and black lettering securely fastened to the equipment with sheet metal screws.
 - 1. Terminology: Match schedules as closely as possible.
 - 2. Data:
 - a. Name and plan number.
 - b. Equipment service.
 - c. Design capacity.
 - d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
 - 3. Size: 2-1/2 by 4 inches (64 by 100 mm) for control devices, dampers, and valves; 4-1/2 by 6 inches (115 by 150 mm) for equipment.
- C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, Engraved phenolic plates white background and black lettering. .Provide holes for mechanical fastening.
 - 1. Data: Instructions for operation of equipment and for safety procedures.
 - 2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
 - 3. Thickness: 1/16 inch (1.6 mm) for units up to 20 sq. in. (130 sq. cm) or 8 inches (200 mm) in length, and 1/8 inch (3.2 mm) for larger units.

4. Fasteners: Self-tapping, stainless-steel sheet-metal screws..

D. Access Panel and Door Markers: 1/16-inch- (1.6-mm-) thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch (3.2-mm) center hole for attachment.

1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.2 PIPING IDENTIFICATION DEVICES

A. Completely paint piping systems in mechanical rooms with the applicable colors listed below with appropriate self-sticking or strap-on identifications and arrows indicating direction of flow.

B. On straight runs of piping, space marking no further than 30 feet apart; and with pre-tentioned Plastic Pipe Markers near each valve, pressure reducing valve, heat exchanger, etc.

C. Where pipe passes through walls or floors, mark near the penetration on both sides. Provide markings at each directional change of all piping systems.

D. Mechanical room and outdoor pipe color and the colors of bands are as follows:

System	Color	Stencil Identification
HVAC Hot Water Supply	Red	HWS
HVAC Hot Water Return	Red	HWR
Steam Supply	Orange	LPS/MPS
Condensate Return	Aluminum	CR
Water, Chilled, Supply	Dark Blue	CHWS
Water, Chilled, Return	Dark Blue	CHWR
Water, Cold Domestic	Dark Green	DOM CW
Supports, Hangers	Black	

E. Additional Labeling requirements

- Colors: Comply with ASME A13.1, unless otherwise indicated.
- Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length
- Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): Full-band pipe markers extending 360 degrees around pipe at each location.
- Pipes with OD, Including Insulation, 6 Inches (150 mm) and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
- Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.

F. Pre-tensioned Pipe Markers: Pre-coiled semi-rigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.

- G. Shaped Pipe Markers: Preformed semi-rigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.
- H. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.
- I. Plastic Tape: Continuously printed, vinyl tape at least 3 mils (0.08 mm) thick with pressure-sensitive, permanent-type, self-adhesive back.
 - 1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): 3/4 inch (19 mm) minimum.
 - 2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches (150 mm) or Larger: 1-1/2 inches (38 mm) minimum.

2.3 VALVE TAGS

- A. Provide brass valve tags for all valves and a schedule under rigid plastic in the mechanical room.

2.4 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.
 - 1. Size: Approximately 4 by 7 inches (100 by 178 mm)
 - 2. Fasteners: Brass grommet and wire
 - 3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
 - 4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

- A. Products specified are for applications referenced in other Division 15 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

- A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
 - 1. Pumps, compressors, chillers, condensers, and similar motor-driven units.

2. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
3. Fans.

3.3 PIPING AND DUCT IDENTIFICATION

- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
 1. Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): Pre-tensioned pipe markers: color-coded.
- B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed locations as follows:
 1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations through walls, floors, ceilings, and nonaccessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings. Omit intermediately spaced markers.

3.4 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

3.5 ADJUSTING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.6 CLEANING

- A. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION 230553

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SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

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 TAB to produce design objectives for the following:
 - 1. Air Systems:
 - a. Constant-volume air systems.
 - b. Variable-air-volume systems.
 - 2. Hydronic Piping Systems:
 - a. Constant-flow systems.
 - b. Variable-flow systems.
 - 3. HVAC equipment quantitative-performance settings.
 - 4. Verifying that automatic control devices are functioning properly.
 - 5. Reporting results of activities and procedures specified in this Section.

1.3 SUBMITTALS

- A. Strategies and Procedures Plan: Within 90 days from Contractor's Notice to Proceed, submit two (2) copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.
- B. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- C. Warranties specified in this Section.

1.4 QUALITY ASSURANCE

- A. TAB Firm Qualifications: Engage a TAB firm certified by AABC or NEBB.
- B. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

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

1.5 PROJECT CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.6 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.7 WARRANTY

- A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
 - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.
- B. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:
 - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
 - 1. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine Project Record Documents described in Division 01 Section "Project Record Documents."
- D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
- F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- G. Examine system and equipment test reports.
- H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

- K. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.
- L. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
- M. Examine strainers for clean screens and proper perforations.
- N. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- O. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- P. Examine system pumps to ensure absence of entrained air in the suction piping.
- Q. Examine equipment for installation and for properly operating safety interlocks and controls.
- R. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices are operated by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.
 - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
 - 4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
 - 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 - 6. Sensors are located to sense only the intended conditions.
 - 7. Sequence of operation for control modes is according to the Contract Documents.
 - 8. Controller set points are set at indicated values.
 - 9. Interlocked systems are operating.
 - 10. Changeover from heating to cooling mode occurs according to indicated values.
- S. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system readiness checks and prepare system readiness reports. Verify the following:
 - 1. Permanent electrical power wiring is complete.
 - 2. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.
 - 5. Balance, smoke, and fire dampers are open.
 - 6. Isolating and balancing valves are open and control valves are operational.

7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.
- B. Cut insulation, ducts and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.
- C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings. Label circuit setters with final setting including flow and dP using a permanent metal tag.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- E. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.

- K. Check for proper sealing of air-handling unit components.
- L. Check for proper sealing of air duct system.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure fan static pressures to determine actual static pressure as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
 - 3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
 - 4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
 - 5. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
 - 6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
 - 1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
 - C. Measure terminal outlets and inlets without making adjustments.
 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
 - D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.
 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.
- 3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS
- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.
 - B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
 1. Set outside-air dampers at minimum, and return- and exhaust-air dampers at a position that simulates full-cooling load.
 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
 3. Measure total system airflow. Adjust to within indicated airflow.
 4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
 5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
 6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.

7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
8. Record the final fan performance data.

3.7 PROCEDURES FOR HYDRONIC SYSTEMS

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

3.8 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

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

3.9 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Water Coils: Measure the following data for each coil:
 - 1. Entering- and leaving-water temperature.
 - 2. Water flow rate.
 - 3. Water pressure drop.
 - 4. Dry-bulb temperature of entering and leaving air.
 - 5. Wet-bulb temperature of entering and leaving air for cooling coils.
 - 6. Airflow.
 - 7. Air pressure drop.
 - 8. Calculate BTU transfer on both air side and water side.
- B. Electric-Heating Coils: Measure the following data for each coil:
 - 1. Nameplate data.
 - 2. Airflow.
 - 3. Entering- and leaving-air temperature at full load.
 - 4. Voltage and amperage input of each phase at full load and at each incremental stage.
 - 5. Calculated kilowatt at full load.
 - 6. Fuse or circuit-breaker rating for overload protection.

3.10 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer, model, and serial numbers.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Efficiency rating.
 - 5. Nameplate and measured voltage, each phase.
 - 6. Nameplate and measured amperage, each phase.
 - 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.11 PROCEDURES FOR TEMPERATURE MEASUREMENTS

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

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

3.12 TEMPERATURE-CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Check free travel and proper operation of control devices such as damper and valve operators.
- F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.
- G. Check the interaction of electrically operated switch transducers.
- H. Check the interaction of interlock and lockout systems.
- I. Check main control supply-air pressure and observe compressor and dryer operations.
- J. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.
- K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.13 TOLERANCES

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

3.14 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.

1. Include a list of instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to certified field report data, include the following:
1. Pump curves.
 2. Fan curves.
 3. Manufacturers' test data.
 4. Field test reports prepared by system and equipment installers.
 5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.
- D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
1. Title page.
 2. Name and address of TAB firm.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB firm who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Data for terminal units, including manufacturer, type size, and fittings.
 14. Notes to explain why certain final data in the body of reports varies from indicated values.
 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outside-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outside, supply, return, and exhaust airflows.

2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

3.15 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230700 – HVAC PIPE 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. Insulation Materials:
 - a. Mineral fiber.
 - b. Polyisocyanurate.
 - c. Flexible elastomeric
- 2. Insulating cements.
- 3. Adhesives.
- 4. Mastics.
- 5. Lagging adhesives.
- 6. Sealants.
- 7. Factory-applied jackets.
- 8. Field-applied fabric-reinforcing mesh.
- 9. Field-applied cloths.
- 10. Field-applied jackets.
- 11. Tapes.
- 12. Securements.
- 13. Corner angles.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Shop Drawings:
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.
 - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
 - 6. Detail application of field-applied jackets.
 - 7. Detail application at linkages of control devices.
 - 8. Detail field application for each equipment type.
- C. Qualification Data: For qualified Installer.

- D. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- E. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000 Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
 - 2. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- G. Mineral-Fiber, Pipe Insulation Wicking System: Preformed pipe insulation complying with ASTM C 547, Type I, Grade A, with absorbent cloth factory applied to the entire inside surface of preformed pipe insulation and extended through the longitudinal joint to outside surface of insulation under insulation jacket. Factory apply a white, polymer, vapor-retarder jacket with self-sealing adhesive tape seam and evaporation holes running continuously along the longitudinal seam, exposing the absorbent cloth.
- H. Polyisocyanurate: Unfaced, preformed, rigid cellular polyisocyanurate material intended for use as thermal insulation.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Apache Products Company; ISO-25.
 - b. Dow Chemical Company (The); Trymer.
 - c. Duna USA Inc.; Corafoam.
 - d. Elliott Company; Elfoam.
 - 2. Comply with ASTM C 591, Type I or Type IV, except thermal conductivity (k-value) shall not exceed 0.19 Btu x in./h x sq. ft. x deg F (0.027 W/m x K) at 75 deg F (24 deg C) after 180 days of aging.

3. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less for thickness up to 1-1/2 inches (38 mm) as tested by ASTM E 84.
4. Fabricate shapes according to ASTM C 450 and ASTM C 585.
5. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.

- a. Pipe Applications: PVDC-SSL.
- b. Equipment Applications: ASJ.

- I. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Products: Subject to compliance with requirements, provide the following:

- a. Aeroflex USA Inc.; Aerocel.
- b. Armacell LLC; AP Armaflex.
- c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Insulco, Division of MFS, Inc.; SmoothKote.
- b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
- c. Rock Wool Manufacturing Company; Delta One Shot.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

- B. Polyisocyanurate: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F (minus 59 to plus 149 deg C).

- C. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F (10 to 427 deg C).

1. Products: Subject to compliance with requirements, provide the following:

- a. Childers Products, Division of ITW; CP-97.
- b. Foster Products Corporation, H. B. Fuller Company; 81-27/81-93.
- c. Marathon Industries, Inc.; 290.
- d. Mon-Eco Industries, Inc.; 22-30.
- e. Vimasco Corporation; 760.

- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Childers Products, Division of ITW; CP-82.
- b. Foster Products Corporation, H. B. Fuller Company; 85-20.

- c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
- E. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Products: Subject to compliance with requirements provide one of the following
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
- F. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); 739, Dow Silicone.
 - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Red Devil, Inc.; Celulon Ultra Clear.
 - e. Speedline Corporation; Speedline Vinyl Adhesive.
- G. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Aeroflex USA Inc.; Aero seal.
 - b. Armacell LCC; 520 Adhesive.
 - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
 - d. RBX Corporation; Rubatex Contact Adhesive.
 - e. MASTICS
- H. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
- I. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
 - 1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.
 - 2. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).
 - 3. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
 - 4. Color: White.
- J. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
 - 1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
 - 2. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
 - 3. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 - 4. Color: White.

2.4 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Polyisocyanurate Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-45.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
 - f. Vimasco Corporation; 750.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
5. Color: White or gray.

B. FSK and Metal Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
4. Color: Aluminum.

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

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
4. Color: White.

2.5 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

2.6 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd. (271 g/sq. m).

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto PVC Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
2. Adhesive: As recommended by jacket material manufacturer.
3. Color: Color-code jackets based on system. See Mechanical Identification Section for Color
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
5. Factory-fabricated tank heads and tank side panels.

C. Metal Jacket:

1. Products: Subject to compliance with requirements provide one of the following:
 - a. Childers Products, Division of ITW; Metal Jacketing Systems.
 - b. PABCO Metals Corporation; Surefit.
 - c. RPR Products, Inc.; Insul-Mate.
2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
 - d. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.8 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Width: 3 inches (75 mm).
 2. Thickness: 11.5 mils (0.29 mm).

3. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

2.9 SECUREMENTS

A. Bands:

1. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 3/4 inch (19 mm) wide with closed seal.
2. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- (3.5-mm-) diameter shank, length to suit depth of insulation indicated.

2.10 CORNER ANGLES

- A. PVC Corner Angles: 30 mils (0.8 mm) thick, minimum 1 by 1 inch (25 by 25 mm), PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils (0.127 mm) thick and an epoxy finish 5 mils (0.127 mm) thick if operating in a temperature range between 140 and 300 deg F (60 and 149 deg C). Consult coating manufacturer for

- appropriate coating materials and application methods for operating temperature range.
- 2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams between the 2 O'clock and 3 o'clock positions
- E. All joints shall be sealed weathertight and with appropriate UV resistant sealant for all exterior applications.
- F. Install multiple layers of insulation with longitudinal and end seams staggered.
- G. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- H. Keep insulation materials dry during application and finishing.
- I. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- J. Install insulation with least number of joints practical.
- K. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- L. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- M. Install insulation with factory-applied jackets as follows:
 1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- N. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- O. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- P. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- Q. For above ambient services, do not install insulation to the following:
 1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation,

- install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
 4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches (50 mm).
1. Comply with requirements in Division 07 Section "Penetration Firestopping" Firestopping and fire-resistive joint sealers.
- E. Insulation Installation at Floor Penetrations:
1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches (50 mm).
 2. Pipe: Install insulation continuously through floor penetrations.
 3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

- A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
 2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
 3. Protect exposed corners with secured corner angles.
 4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches (75 mm) from insulation end joints, and 16 inches (400 mm) o.c. in both directions.
 - d. Do not overcompress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins and attach speed washers.
 - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
 6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches (150 mm) from each end. Install wire or cable between two circumferential girdles 12 inches (300 mm) o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches (1200 mm) o.c. Use this network for securing insulation with tie wire or bands.
 7. Stagger joints between insulation layers at least 3 inches (75 mm).
 8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
 9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
 10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
- B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
 2. Seal longitudinal seams and end joints.
- C. Insulation Installation on Pumps:
1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch (150-mm) centers, starting at corners. Install 3/8-inch- (10-mm-) diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
 2. Fabricate boxes from galvanized steel, at 0.050 inch (1.3 mm) thick.
 3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.6 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular

- surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.

4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.7 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 POLYISOCYANURATE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with tape or bands and tighten without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o'clock positions on the pipe.
2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, same thickness of adjacent pipe insulation, not to exceed 1-1/2-inch (38-mm) thickness.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyisocyanurate block insulation of same thickness as pipe insulation.

C. Insulation Installation on Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of polyisocyanurate insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.9 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.

2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to

3.10 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
 2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- C. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints. Horizontal seams must also be sealed.

3.11 FINISHES

- A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material:
1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: See Mechanical Identification Section for color. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or PVC jackets.

3.12 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.13 EQUIPMENT INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
- B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.
- C. Hot-water pump insulation shall be one of the following:
 - 1. Mineral-Fiber Board: 2 inches (50 mm) thick and 2-lb/cu. ft. (32-kg/cu. M) nominal density.
 - 2. Polyisocyanurate: 1-1/2 inches (38 mm) thick.
- D. Chilled-water pump insulation shall be one of the following:
 - 1. Polyisocyanurate: 1-1/2 inches (38 mm) thick.
 - 2. Flexible elastomeric. 1.5" Thick.
- E. Condensate Receiver insulation shall be one of the following:
 - 1. Mineral-Fiber Board: 2 inches (50 mm) thick and 2-lb/cu. ft. (32-kg/cu. M) nominal density. With canvas jacketing.
- F. Heat Exchangers insulation shall be one of the following:
 - 1. Mineral-Fiber Board: 2 inches (50 mm) thick and 2-lb/cu. ft. (32-kg/cu. M) nominal density. With canvas jacketing.

3.14 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.

2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.
4. Direct buried CHWS and CHWR piping not within 3ft of steam piping or steam condensate piping.

3.15 INDOOR PIPING INSULATION SCHEDULE

- A. Chilled Water Piping: Provide with vapor barrier.
1. NPS 1¼" and Smaller: Insulation shall be one of the following:
 - a. Polyisocyanurate 1-1/2 inches (38 mm) thick.
 - b. Flexible elastomeric. 1.5" Thick.
 2. NPS 1 ½" and Larger: Insulation shall be one of the following:
 - a. Polyisocyanurate 1-1/2 inches (38 mm) thick.
- B. Hot Water Piping:
1. NPS 1¼" and Smaller: Insulation shall be one of the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I, 2 inches (50 mm) thick.
 - b. Flexible elastomeric. 1" Thick.
 2. NPS 1 ½" and Larger: Insulation shall be one of the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I, 2 inches (50 mm) thick.
- C. Steam and condensate piping. (including traps)
1. NPS 1 ½" and Smaller: Insulation shall be one of the following:
 - a. Calcium Silicate 1"
 - b. Mineral-Fiber, Preformed Pipe, Type I, 1 inches (50 mm) thick.
 2. NPS 2" and Larger: Insulation shall be one of the following:
 - a. Calcium Silicate 2"
 - b. Mineral-Fiber, Preformed Pipe, Type I, 2 inches (50 mm) thick.
- D. Refrigerant Suction and Hot-Gas Piping:
1. Insulation shall be one of the following:
 - a. Polyisocyanurate 1-1/2 inches (38 mm) thick.
 - b. Flexible elastomeric. 1.5" Thick.

3.16 OUTDOOR, PIPING INSULATION SCHEDULE

- A. Steam and condensate piping including steam traps
1. NPS 1 ½" and Smaller: Insulation shall be one of the following:
 - a. Calcium Silicate 1"
 2. NPS 2" and Larger: Insulation shall be one of the following:

a. Calcium Silicate 2"

3.17 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Install removable jacketing for steam traps, PRVs, and all serviceable equipment.
- D. Piping, Concealed:
 - 1. None.
- E. Piping, Exposed Finished Areas:
 - 1. PVC, Color-Coded by System, 20 mils (0.5 mm) thick.
- F. Piping, Exposed Main Mechanical Room shall be one of the following, but method shall be consistent for all piping in the room.
 - 1. Woven Glass Cloth Jacket 8oz/sq. yd. Painted per System 2 Coats
 - 2. PVC, Color-Coded by System, 20 mils (0.5 mm) thick.
- G. Piping, Mechanical Closets:
 - 1. None
- H. Equipment, Exposed Main Mechanical Room shall be;
 - 1. Woven Glass Cloth Jacket 8oz/sq. yd. Painted per System 2 Coats
- I. Install removable jacketing for steam traps, PRVs, and all serviceable equipment.
 - 1. High temperature insulated fabric removable jacketing.

3.18 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. Piping, Flanges, Valves, Strainer, and fittings.
 - 1. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - 2. Bands shall be Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 3/4 inch (19 mm) wide with closed seal.
- C. Install removable jacketing for steam traps, PRVs, and all serviceable equipment.

1. High temperature insulated fabric removable jacketing.

3.19 DIRECT BURIED PIPING SYSTEM

1. General: All underground piping for chilled water system distribution shall have a minimum diameter of 4" and shall be cement lined ductile iron.
2. Pipe Joint Restraint Calculations: Submit complete calculations for underground chilled water pipe joints indicating the requirements for restrained and push-on joints. Submission of output data from an approved vendor computer selection/calculation program will be required to justify the use of push-on joints in certain locations. This program shall utilize the depth of cover indicated on the profile drawings.
3. Ductile Iron Pipe: Pipe shall conform to AWWA C151 minimum class 50. All ductile iron pipe shall be cement mortar lined in accordance with AWWA C104 and shall have asphaltic coating. Piping 4" – 12" shall have 350 psig minimum working pressure. Piping 14" – 24" shall have a 300 psig minimum working pressure.
4. Select backfill material shall be provided for bedding and backfill 12" above pipe.
5. System drains and vents – Provide system drains at low points and system vents at high points according to details as attached.
6. Fittings: Fittings for ductile iron pipe shall be ductile iron and rated a minimum of 250 psi working pressure. Fittings shall be cement mortar lined equivalent to the pipe lining.
7. Mechanical Joint Fittings: Comply with AWWA C110. Where restrained joints are identified, use Megalug Series 1100 system or approved equal. Gasket material shall be SBR
8. Push-on Joint: Comply with AWWA C111
9. Butterfly Valves: Comply with AWWA C504. Valve shaft to be type 304 stainless steel. Cast valves from gray or ductile iron. Provide interior coating of body and disk. Valves shall be furnished with buried service gearbox operator, shaft extensions, ground level position indicators and valve boxes.
10. Gate Valves: Comply with AWWA C509. Stem shall be non-rising and shall be cast bronze. Valve body and wedge shall be ductile iron and shall be coated inside and outside with epoxy. The coating shall meet or exceed AWWA C550. Valves shall have a minimum pressure rating of 250 psi. Gate valves shall be US pipe or approved equal.
11. Valve Boxes: Valve boxes shall be 2 piece cast iron with heavy duty traffic weight lid marked with valve number as shown on drawings (such as CWS –22). Valve boxes not in paving shall be supplied with a pre-cast concrete mowing ring.

END OF SECTION 230700

SECTION 230701 - HVAC DUCT 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. Insulation Materials:
 - a. Mineral fiber.
 - 2. Fire-rated insulation systems.
 - 3. Insulating cements.
 - 4. Adhesives.
 - 5. Mastics.
 - 6. Factory-applied jackets.
 - 7. Field-applied fabric-reinforcing mesh.
 - 8. Tapes.
 - 9. Securements.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.
 - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
 - 6. Detail application of field-applied jackets.
 - 7. Detail application at linkages of control devices.
 - 8. Detail field application for each equipment type.
- C. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. CertainTeed Corp.; Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; All-Service Duct Wrap.
- G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide the following:

- a. CertainTeed Corp.; Commercial Board.
- b. Fibrex Insulations Inc.; FBX.
- c. Johns Manville; 800 Series Spin-Glas.
- d. Knauf Insulation; Insulation Board.
- e. Manson Insulation Inc.; AK Board.
- f. Owens Corning; Fiberglas 700 Series.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

1. Products: Subject to compliance with requirements, provide the following:

- a. Insulco, Division of MFS, Inc.; SmoothKote.
- b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
- c. Rock Wool Manufacturing Company; Delta One Shot.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide the following:

- a. Childers Products, Division of ITW; CP-82.
- b. Foster Products Corporation, H. B. Fuller Company; 85-20.
- c. ITW TACC, Division of Illinois Tool Works; S-90/80.
- d. Marathon Industries, Inc.; 225.
- e. Mon-Eco Industries, Inc.; 22-25.

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide the following:

- a. Childers Products, Division of ITW; CP-35.
- b. Foster Products Corporation, H. B. Fuller Company; 30-90.
- c. ITW TACC, Division of Illinois Tool Works; CB-50.
- d. Marathon Industries, Inc.; 590.

- e. Mon-Eco Industries, Inc.; 55-40.
 - f. Vimasco Corporation; 749.
 - 2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
 - 4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
 - 5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
- 1. Products: Subject to compliance with requirements, provide the following:
 - a. Childers Products, Division of ITW; CP-10.
 - b. Foster Products Corporation, H. B. Fuller Company; 35-00.
 - c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
 - d. Marathon Industries, Inc.; 550.
 - e. Mon-Eco Industries, Inc.; 55-50.
 - f. Vimasco Corporation; WC-1/WC-5.
 - 2. Water-Vapor Permeance: ASTM F 1249, 3 perms (2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 200 deg F (Minus 29 to plus 93 deg C).
 - 4. Solids Content: 63 percent by volume and 73 percent by weight.
 - 5. Color: White.

2.5 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
- 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 - 2. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.6 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. inch (4 strands by 4 strands/sq. mm), in a Leno weave, for duct, equipment, and pipe.

2.7 FIELD-APPLIED JACKETS

- A. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005, Temper H-14.
- 1. Sheet and roll stock ready for shop or field sizing.

2. Finish and thickness are indicated in field-applied jacket schedules.
3. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.

2.8 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
2. Width: 3 inches (75 mm).
3. Thickness: 11.5 mils (0.29 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - b. Compac Corp.; 110 and 111.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
 - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
2. Width: 3 inches (75 mm).
3. Thickness: 6.5 mils (0.16 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.9 SECUREMENTS

- A. Aluminum Bands: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 3/4 inch (19 mm) wide with wing or closed seal.

1. Products: Subject to compliance with requirements, provide the following:
 - a. Childers Products; Bands.
 - b. PABCO Metals Corporation; Bands.

- c. RPR Products, Inc.; Bands.
- B. Insulation Pins and Hangers:
 - 1. Capacitor-discharge weld-pins: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
 - 2) GEMCO; Press and Peel.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
 - 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
 - a. Products: Subject to compliance with requirements, provide the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.

3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
 4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches (50 mm).
- E. Insulation Installation at Floor Penetrations:
1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches (50 mm).
- 3.4 Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Firestopping."
- 3.5 MINERAL-FIBER INSULATION INSTALLATION
- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
 - b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.

- f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches (75 mm).
 5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) o.c.
 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
 - b. On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.

- d. Do not overcompress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
- a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches (75 mm).
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

3.6 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07 Section "Firestopping."

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

2. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.8 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in nonconditioned space.
4. Indoor, exposed return located in nonconditioned space.
5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
7. Outdoor, concealed supply and return.
8. Outdoor, exposed supply and return.

B. Items Not Insulated:

1. Factory-insulated flexible ducts.
2. Factory-insulated plenums and casings.
3. Flexible connectors.
4. Vibration-control devices.
5. Factory-insulated access panels and doors.
6. Exhaust Ducts

3.9 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, Supply-Air Duct and Plenum Insulation: Mineral-fiber blanket.

1. Thermal insulation R-Value: R-8
2. Factory FSK Jacket

B. Concealed, Return-Air Duct and Plenum Insulation: Mineral-fiber blanket.

1. Thermal insulation R-Value: R-8
2. Factory FSK Jacket

C. Concealed, Outdoor-Air Duct and Plenum Insulation: Mineral-fiber blanket.

1. Thermal insulation R-Value: R-8
2. Factory FSK Jacket

- D. Main Mechanical Room, Supply-Air Duct and Plenum Insulation: Mineral-fiber board.
 - 1. Thermal insulation R-Value: R-8
 - 2. Field-Applied Woven Fiber Jacket, painted.
- E. Main Mechanical Room, Return-Air Duct and Plenum Insulation: Mineral-fiber board.
 - 1. Thermal insulation R-Value: R-8
 - 2. Field-Applied Woven Fiber Jacket, painted.
- F. Main Mechanical Room, Outdoor-Air Duct and Plenum Insulation: Mineral-fiber board.
 - 1. Thermal insulation R-Value: R-8
 - 2. Field-Applied Woven Fiber Jacket, painted.
- G. Suite Mechanical Closets, Supply-Air Duct and Plenum Insulation: Mineral-fiber board.
 - 1. Thermal insulation R-Value: R-8
 - 2. Factory FSK Jacket.
- H. Suite Mechanical Closets, Return-Air Duct and Plenum Insulation: Mineral-fiber board.
 - 1. Thermal insulation R-Value: R-8
 - 2. Factory FSK Jacket.
- I. Suite Mechanical Closets, Outdoor-Air Duct and Plenum Insulation: Mineral-fiber board.
 - 1. Thermal insulation R-Value: R-8
 - 2. Factory FSK Jacket.

END OF SECTION 230700

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SECTION 230800 - COMMISSIONING OF HVAC

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 SECTION INCLUDES

- A. BAS and equipment testing and start-up
- B. Verification of proper and thorough installation of BAS and equipment
- C. Functional testing of control systems
- D. Documentation of tests, procedures, and installations
- E. Coordination of BAS training
- F. Documentation of BAS Operation and Maintenance materials

1.3 GENERAL DESCRIPTION

- A. This section defines responsibilities of the Mechanical Contractor to commission the BAS in coordination with the Controls Contractor, Test and Balance Contractor, and Architect.
- B. Commissioning is the process of ensuring that all building systems are installed and perform interactively according to the design intent, the systems are efficient and cost effective and meet the owner's operational needs, the installation is adequately documented and that the Operators are adequately trained. It serves as a tool to minimize post-occupancy operational problems. It establishes testing and communication protocols in an effort to advance the building systems from installation to full dynamic operation and optimization.
- C. Commissioning Authority (CA) shall work with the Contractor and direct and oversee the Commissioning process and perform functional performance testing.

1.4 CONTRACTOR RESPONSIBILITIES

- A. Completely install and thoroughly inspect, startup, test, adjust, balance, and document all systems and equipment.
- B. Assist Commissioning Authority in verification and performance testing. This will generally include the following:
 - 1. Attend Commissioning (Cx) progress and coordination meetings.
 - 2. Prepare and submit required draft forms and systems information.

3. Establish trend logs of system operation as specified herein.
 4. Demonstrate system operation.
 5. Manipulate systems and equipment to facilitate testing.
 6. Provide instrumentation necessary for verification and performance testing.
 7. Manipulate control systems to facilitate verification and performance testing.
 8. Train Owner's Representatives as specified in Part III of this section.
- C. Provide a BAS Technician to work at the direction of Commissioning Authority for software optimization assistance for a minimum of 40 hours. Refer to Part 3 for a description of the software optimization.
- D. Compensation for Retesting: Contractor shall compensate Owner for site time necessitated by incompleteness of systems or equipment at time of functional performance testing. All testing failures, which require on-site time for retesting, will be considered actual damages to the Owner. All parties under contract with the Owner who are affected by the retesting shall be included in the contract modification.

1.5 SEQUENCING

- A. The following list outlines the general sequence of events for submittals and commissioning:
1. Submit product data and shop drawings, and receive approval.
 2. Submit BAS logic documentation, and receive approval.
 3. Submit Start-Up Checklists and manufacturer's start-up procedures for all equipment provided by the BAS Contractor.
 4. Install BAS.
 5. Submit BAS Start-Up Test Agenda and Schedule for review.
 6. Receive BAS start up Test Agenda/schedule approval.
 7. Submit Training Plan.
 8. Simulate sequencing and debug program off-line to the extent practical.
 9. Place systems under BAS control where applicable during a scheduled outage.
 10. Perform BAS start up where applicable during a scheduled outage.
 11. Prepare and initiate trend log data storage and format trend graphs.
 12. Submit completed BAS Start-Up Reports and initial draft of the O&M Manuals.
 13. Receive BAS Start Up Report approval and approval to schedule Demonstrations and Commissioning.
 14. Demonstrate systems to Commissioning Authority and Owner.
 15. Submit Trend Logs in format specified.
 16. Receive demonstration approval and approval to schedule Acceptance Period.
 17. Train Owner on BAS operation and maintenance.
 18. Substantial Completion
 19. Begin Acceptance Phase.
 20. Two weeks Operational Test.
 21. Perform Functional Performance Testing.
 22. Receive Acceptance Period approval, which is Functional Completion for the BAS.
 23. Train Owner on final sequences and modes of operation.
 24. Install framed control drawings.
 25. Provide appropriate password access to the Owner.

26. Revise and re-submit record drawings and O&M Manuals.
27. Final Acceptance
28. Begin Warranty Phase.
29. Schedule and begin Opposite Season acceptance period.
30. Receive Opposite Season acceptance period approval
31. Submit as-built drawings and O&M Manuals.
32. Update framed control drawings.
33. Complete Owner Training.
34. End-of-Warranty date/period

PART 2 - PRODUCTS

2.1 INSTRUMENTATION

- A. Instrumentation required to verify readings and test the system and equipment performance shall be provided by this Contractor and made available to Commissioning Authority. Generally, no testing equipment will be required beyond that required to perform Contractors work under these Contract Documents. All equipment used for testing and calibration shall be NIST/NBS traceable and calibrated within the preceding 12-month period. Certificates of calibration shall be submitted.

PART 3 - EXECUTION

3.1 BAS Start-Up TESTING, ADJUSTING, CALIBRATION

- A. Work and/or systems installed under this Division shall be fully functioning prior to Demonstration and Acceptance Phase. Contractor shall start, test, adjust, and calibrate all work and/or systems under this Contract, as described below:
 1. Inspect the installation of all devices. Review the manufacturer's installation instructions and validate that the device is installed in accordance with them.
 2. Verify proper electrical voltages and amperages, and verify that all circuits are free from faults.
 3. Verify integrity/safety of all electrical connections.[For the following control settings, initially use the control setting that was used by existing control system, unless otherwise indicated. For AHUs that use a throttled outside air damper position when minimum outside air is required, contractor shall mark existing minimum outside air damper position to allow replication by new controls.
 4. Coordinate with TAB subcontractor to obtain and CA to fine-tune control settings that are determined from balancing procedures. Record the following control settings as obtained from TAB contractor, and note any TAB deficiencies in the BAS Start-Up Report:
 - a. Minimum outside air damper settings for air handling units
 5. Test, calibrate, and set all digital and analog sensing and actuating devices. Calibrate each instrumentation device by making a comparison between the BAS display and the

- reading at the device, using an instrument traceable to the National Bureau of Standards, which shall be at least as accurate as the device to be calibrated (e.g., if field device is $\pm 0.5\%$ accurate, test equipment shall be $\pm 0.5\%$ accurate over same range). Record the measured value and displayed value for each device in the BAS Start-up Report.
6. Check and set zero and span adjustments for all transducers and transmitters.
 7. For dampers and valves:
 - a. Check for adequate installation including free travel throughout range and adequate seal.
 - b. Where loops are sequenced, check for proper control without overlap.
 - c. For actuators:
 - d. Check to insure that device seals tightly when the appropriate signal is applied to the operator.
 - e. Check for appropriate fail position, and that the stroke and range is as required.
 - f. For pneumatic operators, adjust the operator spring compression as required to achieve close-off. If positioner or volume booster is installed on the operator, calibrate per manufacturer's procedure to achieve spring range indicated. Check split-range positioners to verify proper operation. Record the settings for each device in the BAS Pre-Commissioning Report.
 - g. For sequenced electronic actuators, calibrate per manufacturer's instructions to required ranges.
 8. Check each digital control point by making a comparison between the control command at the CU and the status of the controlled device. Check each digital input point by making a comparison of the state of the sensing device and the Operator Interface display. Record the results for each device in the BAS Start-Up Report.
 9. For outputs to reset other manufacturer's devices (for example, VSDs) and for feedback from them, calibrate ranges to establish proper parameters. Coordinate with representative of the respective manufacturer and obtain their approval of the installation.
 10. Verify proper sequences by using the approved checklists to record results and submit with BAS Start-Up Report. Verify proper sequence and operation of all specified functions.
 11. Verify that all safety devices trip at appropriate conditions. Adjust setpoints accordingly.
 12. Tune all control loops to obtain the fastest stable response without hunting, offset or overshoot. Record tuning parameters and response test results for each control loop in the BAS Start Up Report. Except from a startup, maximum allowable variance from set point for controlled variables under normal load fluctuations shall be as follows. Within 3 minutes of any upset (for which the system has the capability to respond) in the control loop, tolerances shall be maintained (exceptions noted):
 - a. Duct air temperature: $\pm 1^{\circ}\text{F}$.
 - b. Space Temperature: $\pm 2^{\circ}\text{F}$
 - c. Chilled Water: $\pm 1^{\circ}\text{F}$
 - d. Hot water temperature: $\pm 3^{\circ}\text{F}$.

13. For interface and DDC control panels:

- a. Ensure devices are properly installed with adequate clearance for maintenance and with clear labels in accordance with the record drawings.
- b. Ensure that terminations are safe, secure and labeled in accordance with the record drawings.
- c. Check power supplies for proper voltage ranges and loading.
- d. Ensure that wiring and tubing are run in a neat and workman-like manner, either bound or enclosed in trough.
- e. Check for adequate signal strength on communication networks.
- f. Check for standalone performance of controllers by disconnecting the controller from the LAN. Verify the event is annunciated at Operator Interfaces. Verify that the controlling LAN reconfigures as specified in the event of a LAN disconnection.
- g. Ensure that all outputs and devices fail to their proper positions/states.
- h. Ensure that buffered and/or volatile information is held through power outage.
- i. With all system and communications operating normally, sample and record update/annunciation times for critical alarms fed from the panel to the Operator Interface.
- j. Check for adequate grounding of all DDC panels and devices.

14. For Operator Interfaces:

- a. Verify that all elements on the graphics are functional and are properly bound to physical devices and/or virtual points, and that hot links or page jumps are functional and logical.
- b. Output all specified BAS reports for review and approval.
- c. Verify that the alarm printing and logging is functional and per requirements.
- d. Verify that trends are archiving to disk and provide a sample to the Commissioning Authority for review.
- e. Verify that paging/dial-out alarm annunciation is functional.
- f. Verify the functionality of remote Operator Interfaces and that a robust connection can be established consistently.
- g. Verify that required third party software applications required with the bid are installed and are functional.

15. Start-up and check out control air compressors, air drying, and filtering systems in accordance with the appropriate section and with manufacturer's instructions.

16. Verify proper interface with fire alarm system.

- B. Submit Start-Up Test Report: Report shall be completed, submitted, and approved prior to Substantial Completion.

3.2 Sensor CHeckout and Calibration

- A. General Checkout: Verify that all sensor locations are appropriate and are away from causes of erratic operation. Verify that sensors with shielded cable are grounded only at one end. For sensor pairs that are used to determine a temperature or pressure difference, make sure they

are reading within 0.2°F of each other for temperature and within a tolerance equal to 2% of the reading of each other for pressure. Tolerances for critical applications may be tighter.

B. Calibration: Calibrate all sensors using one of the following procedures:

1. Sensors without Transmitters - Standard Application: Make a reading with a calibrated test instrument within 6 inches of the site sensor at various points across the range. Verify that the sensor reading (via the permanent thermostat, gage or BAS) is within the tolerances specified for the sensor. If not, adjust offset and range, or replace sensor. Where sensors are subject to wide variations in the sensed variable, calibrate sensor within the highest and lowest 20% of the expected range.
2. Sensors with Transmitters - Standard Application: Disconnect sensor. Connect a signal generator in place of sensor. Connect ammeter in series between transmitter and BAS control panel. Using manufacturer's resistance-temperature data, simulate minimum desired temperature. Adjust transmitter potentiometer zero until the ammeter reads 4 mA. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the OI. Record all values and recalibrate controller as necessary to conform to tolerances. Reconnect sensor. Make a reading with a calibrated test instrument within 6 inches of the site sensor. Verify that the sensor reading (via the permanent thermostat, gage or BAS) is within the tolerances specified. If not, replace sensor and repeat. For pressure sensors, perform a similar process with a suitable signal generator.

C. Sensor Tolerance: Sensors shall be within the tolerances specified for the device.

3.3 Coil Valve Leak Check

- A. Verify proper close-off of the valves. Ensure the valve seats properly by simulating the maximum anticipated pressure difference across the circuit. Calibrate air temperature sensors on each side of coil to be within 0.5°F of each other. Via the Operator Interface, command the valve to close. Energize fans. After 5 minutes, observe air temperature difference across coil. If a temperature difference is indicated, and the piping surface temperature entering the coil is within 3°F of the water supply temp, leakage is probably occurring. If it appears that it is occurring, close the isolation valves to the coil to ensure the conditions change. If they do, this validates the valve is not closing. Remedy the condition by adjusting the stroke and range, increasing the actuator size/torque, replacing the seat, or replacing the valve as applicable.

3.4 Valve Stroke Setup and Check

- A. For all valve and actuator positions checked, verify the actual position against the Operator Interface readout.
- B. Set pumps to normal operating mode. Command valve closed, verify that valve is closed, and adjust output zero signal as required. Command valve open, verify position is full open and adjust output signal as required. Command the valve to various few intermediate positions. If actual valve position doesn't reasonably correspond, replace actuator or add pilot positioner (for pneumatics).

3.5 BAS DEMONSTRATION

- A. Demonstrate the operation of the BAS hardware, software, and all related components and systems to the satisfaction of the Commissioning Authority and Owner. Schedule the demonstration with the Owner's representative 1 week in advance. Demonstration shall not be scheduled until all hardware and software submittals, and the Start-Up Test Report are approved. If the work fails to be demonstrated to conform with Contract specifications, so as to require scheduling of additional site visits by the Commissioning Authority for re-demonstration, Contractor shall reimburse the Owner for costs of subsequent Commissioning Authority site visits.
- B. The Contractor shall supply all personnel and equipment for the demonstration, including, but not limited to, instruments, ladders, etc. Contractor-supplied personnel must be competent with and knowledgeable of all project-specific hardware, software, and the HVAC systems. All training documentation and submittals shall be at the job site.
- C. Demonstration shall typically involve small representative samples of systems/equipment randomly selected by the Owner and/or Commissioning Authority.
- D. The system shall be demonstrated following the same procedures used in the Start-Up Test by using the approved Commissioning Checklists. Demonstration shall include, but not necessarily be limited to, the following:
 - 1. Demonstrate that required software is installed on BAS workstations. Demonstrate that graphic screens, alarms, trends, and reports are installed as submitted and approved.
 - 2. Demonstrate that points specified and shown can be interrogated and/or commanded (as applicable) from all workstations, as specified.
 - 3. Demonstrate that remote dial-up communication abilities are in accordance with these Specifications.
 - 4. Demonstrate correct calibration of input/output devices using the same methods specified for the Start-Up Tests. A maximum of 10 percent of I/O points shall be selected at random by the Commissioning Authority and/or Owner for demonstration. Upon failure of any device to meet the specified end-to-end accuracy, an additional 10 percent of I/O points shall be selected at random by Commissioning Authority for demonstration. This process shall be repeated until 100 percent of randomly selected I/O points have been demonstrated to meet specified end-to-end accuracy.
 - 5. Demonstrate that all DDC and other software programs exist at respective field panels. The Direct Digital Control (DDC) programming and point database shall be as submitted and approved.
 - 6. Demonstrate that all DDC programs accomplish the specified sequences of operation.
 - 7. Demonstrate that the panels automatically recover from power failures, as specified.
 - 8. Demonstrate that the stand-alone operation of panels meets the requirements of these Specifications. Demonstrate that the panels' response to LAN communication failures meets the requirements of these Specifications.
 - 9. Identify access to equipment selected by Commissioning Authority. Demonstrate that access is sufficient to perform required maintenance.
 - 10. Demonstrate that required trend graphs and trend logs are set up per the requirements. Provide a sample of the data archive. Indicate the file names and locations.

- E. BAS Demonstration shall be completed and approved prior to Substantial Completion.
- F. Any tests successfully completed during the demonstration will be recorded as passed for the functional performance testing and will not have to be retested.

3.6 BAS ACCEPTANCE PERIOD

- A. After approval of the BAS Demonstration and prior to Contract Close out, Acceptance Phase shall commence. Acceptance Period shall not be scheduled until all HVAC systems are in operation and have been accepted, all required cleaning and lubrication has been completed (i.e., filters changed, piping flushed, strainers cleaned, and the like), and TAB report has been submitted and approved.] [Acceptance Period and its approval will be performed on a system-by-system basis if mutually agreed upon by the Contractor and the Government.performed.
- B. Operational Test: At the beginning of the Acceptance Phase, the system shall operate properly for two weeks without malfunction, without alarm caused by control action or device failure, and with smooth and stable control of systems and equipment in conformance with these specifications. At the end of the two weeks, contractor shall forward the trend logs to the Commissioning Authority for review. Commissioning Authority shall determine if the system is ready for functional performance testing and document any problems requiring contractor attention.
 - 1. If the systems are not ready for functional performance testing, Contractor shall correct problems and provide notification to the Owner's representative that all problems have been corrected. The Acceptance Period shall be restarted at a mutually scheduled time for an additional one-week period. This process shall be repeated until Commissioning Authority issues notice that the BAS is ready for functional performance testing.
- C. During the Acceptance Period, the contractor shall maintain a hard copy log of all alarms generated by the BAS. For each alarm received, Contractor shall diagnose the cause of the alarm, and shall list on the log for each alarm, the diagnosed cause of the alarm, and the corrective action taken. If in the Contractor's opinion, the cause of the alarm is not the responsibility of the Contractor, Contractor shall immediately notify the Owner's representative.

3.7 Trend Logs

- A. Contractor shall configure and analyze all trends requires under Section 230993

3.8 TREND Graphs

- A. Trend graphs as specified in Section 230993 shall generally be used during the Acceptance Phase to facilitate and document testing. Prepare controller and workstation software to display graphical format trends during the Acceptance Period. Trend graphs shall demonstrate compliance with contract documents.
- B. Each graph shall be clearly labeled with HVAC subsystem title, date, and times.

3.9 Warranty Phase BAS OPPOSITE SEASON Trending and Testing

- A. Trending: Throughout the Warranty Phase, trend logs shall be maintained as required for the Acceptance Period. Contractor shall forward archive trend logs to the Commissioning Authority for review upon Commissioning Authority request. Commissioning Authority will review these and notify contractor of any warranty work required.
- B. Opposite Season Testing: Within 6 months of completion of the Acceptance Phase, Commissioning Authority shall schedule and conduct Opposite Season functional performance testing. Contractor shall participate in this testing and remedy any deficiencies identified.

3.10 SOFTWARE OPTIMIZATION ASSISTANCE

- A. The Contractor shall provide the services of a BAS Technician as specified above at the project site to be at the disposal of the Commissioning Authority. The purpose of this requirement is to make changes, enhancements and additions to control unit and/or workstation software that have been identified by the Commissioning Authority during the construction and commissioning of the project and that are beyond the specified Contract requirements. The cost for this service shall be included with the bid. Requests for assistance shall be for contiguous or non-contiguous 8-hour days, unless otherwise mutually agreed upon by Contractor, Commissioning Authority, and Owner. The Owner's representative shall notify contractor 2 days in advance of each day of requested assistance.
- B. The BAS Technician provided shall be thoroughly trained in the programming and operation of the controller and workstation software. If the BAS Technician provided cannot perform every software task requested by the Commissioning Authority in a timely fashion, contractor shall provide additional qualified personnel at the project site as requested by the Commissioning Authority, to meet the total specified requirement [per building] on-site.

3.11 BAS OPERATOR TRAINING and O&M manuals

- A. Provide up to 4 complete sets of the approved Operations and Maintenance (O&M) Manuals (hard copy and one electronic copy) to be used for training.
- B. Contractor shall submit a Training Plan for the scope of training for which they are responsible. Training Plan shall be forwarded to the Division 23 Contractor who will compile, organize, format, and forward to the Engineer for review.
- C. The manufacturer and the controls contractor shall provide training for two (2) university employees at the manufacturer's training facility. Include all travel, lodging and expenses for the trainer or the university personnel. The training shall be documented and a syllabus must be submitted and approved by Facilities Operations prior to the training. The training should include the following:
 - 1. Programming logic changes both local control and system (BCU)
 - 2. Expansion of the control system including hardware and software additions
 - 3. Graphics generation
 - 4. HVAC control systems

- D. On-Site Training: Provide services of controls contractor's qualified technical personnel for 3, 8-hour days to instruct Owner's personnel in operation and maintenance of BAS. Instruction shall be in classroom setting at the project site for appropriate portions of the training. Training may be in non-contiguous days at the request of the Owner. The Owner's representative shall notify contractor 1 week in advance of each day of requested training. The Contractor's designated training personnel shall meet with the Engineer and Owner's representative for the purpose of discussing and fine-tuning the training agenda prior to the first training session. Training agenda shall generally be as follows:

1. Basic Operator Workstation (OWS) Training – For all potential users of the OWS:
 - a. Brief walk-through of building, including identification of all controlled equipment and condensed demonstration of controller portable and built-in operator interface device display capabilities.
 - b. Brief overview of the various parts of the O&M Manuals, including hardware and software programming and operating publications, catalog data, controls installation drawings, and DDC programming documentation.
 - c. Demonstration of workstation login/logout procedures, password setup, and exception reporting.
 - d. Demonstration of workstation menu penetration and broad overview of the various workstation features.
 - e. Overview of systems installed.
 - f. Present all site-specific point naming conventions and points lists, open protocol information, configuration databases, back-up sequences, upload/download procedures, and other information as necessary to maintain the integrity of the BAS.
 - g. Overview of alarm features.
 - h. Overview of trend features.
 - i. Overview of workstation reports.
2. BAS Hardware Training – For Maintenance and Control Technicians
 - a. Review of installed components and how to install/replace, maintain, commission, and diagnose them
3. BAS Technician Training:
 - a. Introduction to controller programming and overview of the programming application interface.
 - b. General review of sequence of operation and control logic for the project site, including standalone and fail-safe modes of operation.
 - c. Uploading/Downloading and backing up programs.
 - d. Network administration.
 - e. Review of setpoint optimization and fine-tuning concepts.

END OF SECTION 230800

SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

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 SYSTEM FEATURES AND ARCHITECTURE

- A. The controls system shall be web based and be capable of integrating multiple building functions including equipment supervision and control, alarm management, energy management and historical data collection.

1.3 SUBMITTALS

- A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

- 1. Each control device labeled with setting or adjustable range of control.

- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

- 1. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
 - 2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
 - 3. Details of control panel faces, including controls, instruments, and labeling.
 - 4. Written description of sequence of operation.
 - 5. Schedule of dampers including size, leakage, and flow characteristics.
 - 6. Schedule of valves including leakage and flow characteristics.
 - 7. Trunk cable schematic showing programmable control unit locations and trunk data conductors.
 - 8. Listing of connected data points, including connected control unit and input device.
 - 9. System graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.
 - 10. System configuration showing peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.

- C. Software and Firmware Operational Documentation: Include the following:

- 1. Software operating and upgrade manuals.

2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
 3. Device address list.
 4. Printout of software application and graphic screens.
 5. Software licenses required by and installed for DDC workstations, laptops, engineering tools and control systems.
- D. Software Upgrade Kit: For Owner to use in modifying control software or web pages to suit future power system revisions or monitoring and control revisions.
- E. Maintenance Data: For systems to include in maintenance manuals. Include the following:
1. Maintenance instructions and lists of spare parts for each type of control device and compressed air station.
 2. Interconnection wiring diagrams with identified and numbered system components and devices.
 3. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
 4. Calibration records and list of set points.
- F. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors. Revise Shop Drawings to reflect actual installation and operating sequences.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer with at least 10 years of experience who is an approved installer of the automatic control system manufacturer for both installation and maintenance of units required for this Project.

1.5 WARRANTY and SERVICE

- A. The Contractor shall warrant the system to be free from defects in material and workmanship for a period of two (2) years from the date of final acceptance of the work by the owner. Any defects shall be repaired or replaced, including materials and labor at no cost to the owner.
- B. The Contractor shall provide one (1) year of maintenance service for the HVAC controls system to begin concurrently with the 1st year of warranty. Service shall include inspection and adjustment of all operating controls and components. The service shall be performed every 3 months and documentation of service shall be provided to Facilities Operations.

1.6 EXTRA MATERIALS

- A. Furnish the following extra materials to Facilities Operations at completion
1. 1 sensor of each type (Hydronic, air supply, humidity)
 2. 2 zone thermostats

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. HVAC controls system contractor shall provide a fully integrated system, UL listed, incorporating direct digital control for energy management, equipment monitoring and control as manufactured by: (Bid alternate M-1 and M-2 – Preferred Manufacturer Alternate)
1. Schneider Electric Buildings Americas ,Invensys IA series controls
 2. Johnson Controls, Metasys Extended Architecture Controls

2.2 DDC EQUIPMENT (Workstations, laptops, printers, software, DDC control units

A. Building Control Unit

1. The Building Control Unit (BCU) is the electronic link between the respective building and the campus network and shares information among all the DDC stand-alone panels within the respective building.
2. The building BCU shall be a networking stand-alone energy management panel enclosed in a sturdy metal enclosure. The microcomputer shall be at the least 16 bits. The microcomputer shall utilize a multi - tasking, multi - user operating system. The BCU shall have peripheral ports for a CRT, a printer, and an auto answer / auto dial modem, and network communications. The BCU shall have a battery back - up for the clock.
3. The building BCU shall be placed on the control vendor's Local Area Network (LAN) configuration within the respective building via its BUS ports. Fault tolerant operation of the Local Area Network shall guarantee that failure in communication or operation of any DDC controllers on the LAN shall not interrupt the communication between remaining units. The BCU shall also be connected to the Campus Wide Area Network via Ethernet connection with communications based on TCP/IP protocol. This connection is via the communication port. The BCU shall be furnished with a built-in software library.
4. The Ethernet card shall reside in the BCU. It shall communicate with the network via a 100 Mbps network adapter
5. The BCU shall have an operator interface port that allows a laptop to direct connect to the BCU and the individual local controllers. The interface connection shall provide all necessary communication so that the laptop can display visual indication of analog variables, binary (status) condition, and adjustment values, automatic operation, trouble, alarm condition and value, manual or override condition.
6. There shall be only one Ethernet connection per building to the University wide area network. The Ethernet connection may not be located in University telecommunication rooms. A standard University voice/data outlet should be installed adjacent to the BCU. The building control contractor shall be responsible for all Ethernet wiring, routers, or other hardware associated with Ethernet communication within the control system local area network. Control system Ethernet wiring shall not reside in the University telecom raceways.
7. A Laptop computer shall be provided that is capable of communication with the controls network through the BCU connection.
8. The laptop shall be capable of direct connecting with any controller in the system as well as the BCU. The laptop shall have all engineering software loaded and operational so that local control sequences can be modified as well as global control and point mapping in the

BCU. The laptop shall be provided with all necessary communication cables and communication adapters to direct connect to local controllers as well as the BCU.

B. DDC Controllers

1. DDC Controllers (stand-alone) shall be microprocessor-based with a minimum word size of 16 bits. They shall also be multi-tasking, multi-user, real-time digital control processors consisting of modular hardware with plug-in enclosed processors, communication controllers, power supplies and input/output point modules. Controller size shall be sufficient to fully meet the requirements of this specification.
2. Control of the mechanical systems shall be performed by a field programmable microprocessor-based direct digital controller (DDC), which incorporates closed loop control algorithms, all necessary energy management functions, and provides for digital display and convenient local adjustments of desired variables at the controller cabinet. Systems, which require the existing user-defined database to be reentered through the operator's terminal after a failure or power interruption, shall not be acceptable.
3. Each unit shall be capable of performing the following energy management functions:
 - a. Start/stop optimization
 - b. Time of day scheduling
 - c. Enthalpy economizer control
 - d. Supply air reset
 - e. Chilled water reset
 - f. Hot water reset
 - g. Event initiated programs
 - h. Night setback
 - i. Chiller sequencing
 - j. Chiller load monitoring
4. Each DDC shall be capable of performing all specified control functions in a completely independent manner. Additionally, DDCs shall be capable of being networked for single point programming and for the sharing of information between panels, including, but not limited to, sensor values, calculated point values, control set-points, tuning parameters, and control instructions.
5. Each DDC controller shall include its own microcomputer controller, power supply, input/output modules, termination modules, battery, and spare AC outlet. The battery shall be continuously charged and be capable of supporting all memory for a minimum of 72 hours. Upon restoration of system power, the control unit shall resume full operation without operator intervention.
6. Each DDC controller shall have at least one RS-232 communication port.

C. Building Operator Laptop computer: Provide as a minimum an IBM-compatible microcomputer with minimum configuration as follows:

1. Processor: Intel .2.5 GHz or better multi core processor, 8GB RAM, 1 GB Cache
2. Graphics: SVGA, minimum 1280 x 1024 pixels, 1 GB EDO video memory.
3. Screen: Minimum 17 inches
4. Standard keyboard, mouse and 1 GB flash drive.

5. Hard-Disk Drive: 500 GB or larger.
6. CD/DVDR-RW Drive: 48x.
7. Easily accessible USB ports on the laptop.
8. Gigabit Ethernet card
9. Operating System: Microsoft Windows Seven loaded and operational.
10. Prefer IBM, Dell or Compaq/HP

D. Graphic Display Requirements

1. Provide a windows based software package for the preparation of system graphics. The package shall be designed to work on the University's server infrastructure.
2. Include with this software a library of HVAC symbols such as fans, pumps, chillers, etc.
3. This section establishes standards for graphic displays as follows.
 - a. All operator workstations including the Laptop shall be programmed to display graphical representations of the mechanical systems and floor areas for which this system has control. Systems to be displayed include the air handlers, air terminal units, chillers, heat converters, pumping systems and similar mechanical devices.
 - b. Floor plans displays are required and shall indicate the approximate positions of controlled mechanical system elements, to include space temperature, within the floor layout.
 - c. All displays shall show real time data to include temperatures and run status.
 - d. The owner prior to installation on the web servers shall approve all graphic pages.
 - e. Summary pages to tabulate VAV box data including space temp, setpoint, box airflow, and DA temp, airflow setpoint, requested damper position, and HW valve position.

E. Application Software: Include the following:

1. Input/output capability from operator station.
2. Operator system access levels via software password.
3. Database creation and support.
4. Dynamic color graphic displays.
5. Alarm processing.
6. Event processing.
7. Automatic restart of field equipment on restoration of power.
8. Data collection.
9. Graphic development on workstation.
10. Maintenance management.

2.3 CONTROL PANELS

- A. Panels shall have hinged doors and be marked with engraved labels. Panels used as a location for mounting control devices shall have a document holder located on the inside of the door.
- B. Provide common keying for all panels
- C. Entrance and exit wiring should be on the panel sides.

- D. All heat generating devices shall be located at the top of the panel.

2.4 SENSORS and TRANSMITTERS

A. Humidity Sensors

1. Accurate to $\pm 3\%$
2. Room sensors; 20 – 90 % RH. Cover to match room thermostat.
3. Duct and outside air sensor; 0 – 100% RH
4. Duct and O.A. sensors that are used in an O.A. enthalpy calculation should be $\pm 2\%$

B. Pressure Sensors

1. Duct static pressure sensors shall have an accuracy of $\pm 1\%$ of range
2. Low-range Space differential pressure sensors: with range of $\pm 0.1"$ W.C. and accuracy of $\pm 1\%$ of range

C. Temperature Sensors

1. Platinum or nickel RTD, 100 or 1000 ohm, accurate to $\pm 0.5\%$ or 10,000 ohm thermistors accurate to $\pm 0.5\%$ across entire operating range of sensor.
2. Outside air sensors shall be shielded from solar radiation by both installation location and finned radiant energy rejection container.
3. Temperature sensors used in BTU calculations shall be a matched pair with a differential accuracy of $\pm 0.15^\circ\text{F}$ over entire range and supplied by the BTU system manufacturer.
4. Room space sensors may be thermistor type.

D. Transducers

1. Provide a minimum $1\frac{1}{4}"$ pressure gauge or LCD pressure display at the output of each I/P and E/P transducer

E. Current Sensors

1. Proof of run for pumps and fans shall be by current sensed devices. If the proof of run cannot be adjusted to take into account variable speed operation and loss of load then an alternative device must be provided to confirm loss of load. As well as proof of motor operation.

2.5 METERS

- See specification 230519 for meter specifications, also reference the latest spec from NCSU Utilities Services Dept; July 2018 edition.

2.6 SENSORS

A. Space Thermostats

1. All room thermostats in labs, classrooms and offices shall have exposed setpoint adjustment with internal stops or software stops for minimum and maximum setting initially set between 68 degrees and 76 degrees
2. All room thermostats in public areas will have concealed setpoint adjustments with blank cover.
3. Insulated mounting bases on exterior walls
4. Accuracy to $\pm 0.5\%$
5. Each thermostat shall be capable of reporting the space temperature and setpoint. In addition, each shall be capable of remote reset by the DDC system
6. Provide with override request and local setpoint adjust except where indicated (vestibules, elevator lobbies and corridors)
7. Label thermostats for VAV boxes with the VAV box that it controls.

2.7 CONTROL VALVES and ACTUATORS

A. General

1. All control valves for HVAC equipment within mechanical equipment rooms and central station units shall utilize electronic actuation. Butterfly valves for air handling unit coil control are unacceptable unless they are high performance type and only with approval from the owner.
2. Preheating and cooling valves shall not be software interlocked so that both valves cannot be opened simultaneously except for override
3. Operator bodies shall be metal

B. Hydronic Valves

1. Valves shall be sized so that pressure drop across valve is at least 25% of the coil pressure drop at full design flow.
2. For systems attached to the campus chilled water loops, pressure independent control valves shall be used at all cooling coils including small fan-coil units. Globe, butterfly or ball valves with automatic flow limiting devices attached are not an appropriate substitute for pressure independent control valves.
3. Valves shall remain closed (zero leakage) against 100% of the full shutoff head of the pump.
4. High performance butterfly valves shall have adjustable packing, EPDM seat with suitable metal back-up ring, upper and lower shaft thrust bearings, 316 SS one piece shaft and 316 SS disc with offset shaft/disc design. Valves shall be provided with electric proportional, 4-20 ma or 0–10 VDC signal with positive positioning mechanism.. Valves and actuators shall be manufactured by the valve manufacturer.
5. Valves shall be equal percentage. Install three-way valves were indicated on plans.
6. Two-position valves shall be line size.
7. Valve service rating shall be 125 psig. or greater except that valves in the campus chilled water piping shall be rated at 250 psig. or greater. The shaft to which the actuator(s) is coupled shall be square or hexagonal or round with one side flattened, to achieve secure coupling.
8. Terminal reheat valves shall be electric proportional, 4-20 ma or 0–10 VDC signal with positive positioning mechanism. Floating point or step control is not allowed. Prefer to use characterized flow ball valves.
9. Valves shall have stainless steel trim and seat.

C. Steam system characterized control valves shall have the following characteristics:

1. Manufacturers (Acceptable)
 - a. Belimo
 - b. Spence
 - c. Seimens
2. Class 125 brass(DZR)
3. Internal Construction:
 - a. Stainless Steel Ball
 - b. ETFE Seat
 - c. Stainless Steel Seat
 - d. Characterizing Plate: Stainless Steel
 - e. Viton Packing
4. Sizing: For pressure drop based on the following services:
 - a. Two Position: 20 percent of inlet pressure.
 - b. Modulating [15-psig (103-kPa) Steam]: 80 percent of inlet steam pressure.
 - c. Modulating [16- to 50-psig (110- to 350-kPa) Steam]: 50 percent of inlet steam pressure.
 - d. Modulating [More Than 50-psig (350-kPa) Steam]: 20 percent of inlet steam pressure.
5. Flow Characteristics: Modified linear characteristics.
6. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of operating (inlet) pressure.

2.8 PRESSURE INDEPENDENT CONTROL VALVES

A. Manufacturers

1. Griswold Controls
2. Delta P
3. Belimo

B. Pressure Independent Actuated Ball Valves

1. Description: The pressure independent modulating control valve shall include a Pressure Compensating Cartridge, Actuated Ball Valve, and Manual Isolation Ball in a single valve housing.
 - a. Valve housing shall consist of forged brass, rated at no less than 360 psi at 250°F.
 - b. The control valve shall accurately control the flow from 0 to 100% full rated flow.
 - c. A universal mounting plate shall allow installation of actuators meeting the system electrical requirements and valve torque requirements as provided by Belimo, Honeywell, Johnson Controls, KMC, Neptronics, Siemens, or Schneider Electric.
 - d. The actuator and plate can be rotated after mounting.

e. Pressure Compensating Cartridge (PCC)

- 1) PCC shall automatically compensate for pressure changes in valve and shall maintain a constant pressure drop across the flow limiting actuated ball.
- 2) The operating pressure range shall be available with the minimum range requiring 7 PSID to actuate the mechanism, or the minimum as scheduled.
- 3) Valve internal control mechanism includes a diaphragm and full travel linear coil spring.
- 4) Valves shall include an accessible/ replaceable cartridge.
- 5) Dual pressure/temperature test valves for verifying the pressure differential across the cartridge and flow limiting ball shall be standard.

f. Actuated Ball Valve

- 1) Valve ball shall consist of chemically plated nickel brass or stainless steel.
- 2) Actuator stem shall be removable/replaceable without removing valve from line.
- 3) Manufacturer shall be able to provide ball insert to limit flow to maximum flow rate with $\pm 5\%$ accuracy.
- 4) Valve shall have EPDM O-rings behind the seals to allow for a minimum close-off pressure of 100 psi with 35 in-lbs of torque for 1/2" – 2" sizes.
- 5) Actuator shall provide minimum torque required for full valve shutoff position.

2. Warranty

All components shall be warranted by manufacturer for no less than one year from date of purchase.

2.9 DAMPERS and ACTUATORS

A. Dampers:

1. Maximum blade width of 8" with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
2. Provide low leakage control dampers where not furnished with packaged units. Damper leakage rate shall not exceed 10 CFM/sq. ft. at 4" wg. Dampers shall have blade seals and stops. The shaft to which the actuator(s) is coupled shall be square or hexagonal or round with one side flattened, to achieve secure coupling.
3. Provide electric proportional, 4-20 ma or 0–10 VDC signal with positive positioning mechanism actuators for all automatic control dampers except dampers in VAV terminal units. Locate damper actuators outside of the air stream. Positioning relays will be provided for each damper section: one each for outside air, return air and relief air.
4. Control dampers used for outside air or exhaust shall be installed a minimum of 6" away from wall penetrations to allow for external mounting of actuators.
5. Throttling operation shall be opposed blade type.
6. Floating point or step control not allowed.

B. Actuators

1. Operator bodies shall be metal except for VAV box actuators
2. Damper and VAV box actuators shall directly couple around damper shaft

2.10 THERMAL AIRFLOW STATIONS

A. Source Limitations: Obtain airflow and temperature measuring sensors and transmitters from single manufacturer.

B. Description: Airflow station shall consist of one or more sensor probes and a remotely mounted microprocessor-based transmitter.

C. Performance:

1. Capable of independently processing up to 16 independently wired sensor assemblies.
2. Airflow rate of each sensor assembly shall be equally weighted and averaged by transmitter prior to output.
3. Temperature of each sensor assembly shall be velocity weighted and averaged by transmitter prior to output.
4. Listed and labeled by an NRTL as successfully tested as an assembly according to UL 873, "Temperature-Indicating and Regulating Equipment."
5. Components shall be interconnected by exposed NRTL- listed plenum-rated cable or non-listed cable placed in conduit.
6. Each flow station shall be factory calibrated at a minimum of 16 airflow rates and three temperatures to standards that are traceable to NIST.
7. Airflow Accuracy: Within 3 percent of reading over the entire operating airflow range.
 - a. Devices whose accuracy is combined accuracy of transmitter and sensor probes must demonstrate that total accuracy meets the performance requirements throughout the measurement range.
 - b. Temperature Accuracy: Within 0.2 deg F over entire operating range minus 20 to plus 140 deg F.
 - c. Sensor and Transmitter Ambient Operating Humidity Range: Zero to 99 percent, non-condensing.
 - d. Instrument shall compensate for changes in air temperature and density throughout calibrated velocity range for seasonal extremes at Project location.
 - e. Pressure Drop: 0.05-inch wg at 2000 fpm across a 24-by24-inch area.
 - f. Instruments mounted in throat or face of fan inlet cone shall not negatively influence the fan performance by reducing flow more than 2 percent of Project design flow or negatively impact fan-generated sound. Losses in performance shall be documented with submittal data, and adjustments to compensate for performance impact shall be made to fan in order to deliver Project design airflow indicated.

D. Sensor Assemblies:

1. Each sensor probe shall contain two individual wired, hermetically sealed bead-in-glass thermistors.

2. Mount thermistors in sensor using a marine-grade, waterproof epoxy.
3. Thermistor leads shall be protected and not exposed to the environment.
4. Each Sensor assembly shall independently determine airflow rate and temperature at each measurement point.
5. Each sensor probe shall have an integral cable for connection to remotely mounted transmitter.
6. Sensor Probe Material: Gold anodized, extruded 6063 aluminum tube or Type 304 stainless steel.
7. Probe Assembly Mounting Brackets Material: Type 304 stainless steel.

E. Casing:

1. Factory mount sensor probes in an airflow station casing to create a single assembly for field mounting.
2. Material: Galvanized sheet steel at least 0.079 thick with coating complying with ASTM A 653/A 653 M, G90. Casings shall be stainless steel, 0.0781 inch thick, when connected to stainless duct and aluminum, 0.063 inch thick, when connected to aluminum duct.
3. Joints and Seams: Continuously weld. Clean galvanized areas damaged by welding and coat with zinc-rich paint.
4. Casing Depth: At least 8 inches.
5. Include casing inlet and discharge connections with a minimum 1.5-inch face flange.

F. Transmitter:

1. Integral digital display capable of simultaneously displaying total airflow and average temperature, individual airflow and temperature readings of each independent sensor assembly.
2. Capable of field configuration and diagnostics using an onboard push-button. Interface and digital display.
3. Include an integral power switch to operate on 24-V ac (isolation not required) and include the following:
4. Integral protection from transients and power surges.
5. Circuitry to ensure reset after power disruption, transients, and brownouts.

2.11 LABELS AND TAGS

1. Provide labels for all field devices including sensors, meters, transmitters and relays. Labels shall be plastic laminate and located adjacent to the device.
2. Labels of field devices (both locally and software ID's) shall be associated with their respective air handler, boiler, chiller, etc.
3. Junction box covers shall be painted yellow and labeled "DDC"

2.12 CONTROL WIRING

1. All control wiring shall be a minimum of No. 18 gauge.
2. All Control Wiring shall be in conduit see 260519.

PART 3 - EXECUTION

3.1 INSTALLATION

1. All wiring shall be in conduit. Conduit shall be run parallel or perpendicular to walls and building lines. Junction box covers shall be painted yellow and labeled "DDC"
2. Wires shall be labeled with mechanically prepared labels at their connection point to each apparatus point of connection.
3. Wiring shall not use the voice/data wire way/conduit systems as pathways.

3.2 ON-SITE TESTING

A. When installation is complete, the controls contractor shall perform the following:

1. A 100% field calibration of all sensors and equipment.
2. Verification of each control point by comparing the control command and the field device. from the end device through the associated graphic point.
3. Documentation of results shall be provided to the University prior to final acceptance.
4. Sequence of operation testing of all programmed sequences.
5. Contractor shall perform an on-site test simulating an Ethernet failure and verify that all sequences continue to perform as designed without external communications.

3.3 DEMONSTRATION

A. The controls contractor shall demonstrate that controls are installed, adjusted and operate as required by the drawings and specifications. This demonstration shall be documented and may be conducted in conjunction with the training of University personnel. The documentation shall identify the item, the person performing the demonstration, date, and the signature of the University's representative. The University's Representative will select the items to be demonstrated. Items shall be demonstrated as follows:

Item Demonstrated	Controls Contractor (Name)	University's Representative (Signature)	Date
1. Disconnect one DDC from the building network to demonstrate that a single device failure will not disrupt peer-to-peer communication			
2. Manually generate alarms at ___ points and demonstrate that the workstation(s) receive the alarms			
3. Calibration has been performed on at least sensors			
4. Point-to-point verification of the greater of points or (___) % of all points. Include labeling of points.			

5. Sequence of operation for the air handling units including economizer cycle, reset , start/stop,			
6. Sequence of operation for the chilled water system including chiller(s)			
7. Sequence of operation for the hot water system			
8. Sequence of operation for ___ VAV terminal units including min/max air, reset,			
9. Sequence of operation for the boiler and steam system			
10. Sequence of operation of the HVAC controls system during a fire alarm			
11. Fail safe operation of AHU, chilled water system, steam and boiler system, hot water system , and terminal units.			
12. Graphics system is functional and that the layout is consistent with field conditions.			
13. Response to upset conditions and change of setpoint for selected systems			

- B. Contractor shall support 3rd party commissioning. Prior to commencing Commissioning all items in sections 230900 3.2 and 3.3.A shall be completed and the results provided to the Owners Commissioning Authority. See spec section 230800 for all Commissioning requirements:

3.4 TRAINING

- A. The manufacturer and the controls contractor shall provide on-site training in the maintenance and operation of the installed system for up to six (6) personnel. The training shall be documented and a syllabus and O&M manuals shall be submitted and approved by Facilities Operations 2 weeks prior to the training. The training should include the following:
1. HVAC systems layout including the locations of air handlers, DDC controllers, VAV boxes, pumps, chillers. This will include a walk-thru at the building.
 2. Sequence of operations for each control loop.
 3. Accessing the control system including:
 - a. Logon procedure
 - b. Use of graphic and DDC pages
 - c. Password requirements
 4. Operation and troubleshooting including:
 - a. Modification of setpoints, schedules
 - b. Overview of graphics and text pages
 - c. Trending of points
 - d. Calibration and adjustment

- e. Hands on training in the troubleshooting and replacement of components including sensors, transmitters, control valves and actuators. Contractor shall have examples of each component and demonstrate measurement of input and output signals, and any operator adjustments available.
 - f. DDC controller functions and operation
- 5. Review of O&M manual and control system as-builts.
- B. The controls contractor shall provide an additional on-site training session nine (9) months after project completion. The purpose of the session will be to review any operational problems that have developed. In addition, the contractor will lead Facilities Operations personnel through a comprehensive annual preventative maintenance of the controls system. This shall be scheduled at least one (1) month in advance.
- C. The manufacturer and the controls contractor shall provide training for two (2) university employees at the manufacturer's training facility. Include all travel, lodging and expenses for the trainer or the university personnel. The training shall be documented and a syllabus must be submitted and approved by Facilities Operations prior to the training. The training should include the following:
 - 1. Programming logic changes both local control and system (BCU)
 - 2. Expansion of the control system including hardware and software additions
 - 3. Graphics generation
 - 4. HVAC control systems

END OF SECTION 230900

SECTION 230975 – ADJUSTABLE FREQUENCY DRIVE 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 MECHANICAL GENERAL PROVISIONS

- A. The Contractor shall conform to the General Conditions.

1.3 WORK INCLUDED

- A. Adjustable frequency drive units

1.4 QUALITY ASSURANCE

- A. All components to be UL listed or labeled.
- B. All wiring to conform to the NEC.
- C. All enclosures to be NEMA rated.
- D. All drives exposed to weather or wet situations shall be enclosed in a NEMA 3R enclosure.
- E. All units shall conform to Part 15 of the FCC regulations on RFI/EMI emissions.
- F. The power converter section of every VFD shall be tested with an actual AC induction motor while loaded and temperature cycled within an environment chamber at 40° C (104° F).
- G. After installation the manufacturer's representative of the equipment provided in this section shall certify in writing to the Owner's representative that the equipment has been assembled and installed within the guidelines of the manufacturer's written installation instructions and that its performance meets or exceeds the operating characteristics specified and/or scheduled and that its emissions are within the limits set by the aforementioned regulations.
- H. A Field Service Engineer is to be provided for start up assistance for the drive and its related motor. Start up assistance shall consist of verifying factory performance standards for the drive and aiding in establishing reference speed points for control of the motor.
- I. Provide warranty period for VFDs and any bypass for 36 months minimum, inclusive of parts, travel, labor and shipping required for repair from date of shipment.

1.5 SUBMITTALS

- A. Submit complete performance and dimensional data along with construction details and wiring diagrams.

- B. Submit manufacturer's installation instructions.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Adjustable Frequency Drive Units:

1. ABB
2. Square D
3. Danfoss-Graham

2.2 EQUIPMENT REQUIREMENTS

- A. The inverters are to be selected for operation with the motors provided for this project. The drive system shall provide an input power factor of 95% throughout the entire speed range. The inverter shall not contribute 5th or 7th harmonic current to the power distribution system or contain the appropriate filter network to limit those harmonics to not more than 5% of the theoretical value.
- B. The input power section of the power converter shall utilize a full wave bridge frequency AC line power to fixed DC voltage. This power section shall be insensitive to phase rotation of the AC line. The output power section of the power converter shall change fixed DC voltage to adjustable frequency AC voltage, utilizing insulated gate bipolar transistors (IGBTs).
- C. The inverter shall be a 12-pulse width modulating type for maximum reliability and provide inherent short circuit protection. The inverter shall be capable of withstanding an output phase to phase, phase to ground short circuit and inverter semi-conductor short circuit, without causing a failure to the inverter. The drive system shall provide a near unity power factor. It is to provide operation of the fan motors as scheduled. Units shall be mounted in a NEMA 12 or better enclosure, and shall be rated for installation in a plenum environment. The following equipment and features are to be incorporated:
 1. Fully range minimum and maximum speed adjustment with ability to automatically select speeds.
 2. Adjustable linear acceleration and deceleration, each separately adjustable.
 3. Field adjustable or automatic current limit.
 4. Inherent short circuit protection.
 5. All units shall operate from 4-20 ma signal in automatic mode.
 6. Under voltage and over voltage protection.
 7. Over temperature protection.
 8. Be rated to provide 100% of rated current, minimum 110% break away current.
 9. Inverter is to be rated for an input line voltage variation of +10% and -5%.
 10. Inverter is to include a door interlocked disconnect switch or circuit breaker. If integral disconnect is not supplied, the manufacturer shall furnish a separate disconnect with inverter. Manufacturer shall also furnish all step-up/step-down transformers required if inverter and motor are not ground voltage. Current limiting fuses shall be wired to the power converter input, and shall be installed in the combination enclosure.

11. The following are to be included in the inverter cabinet:
 - a. Filtered ventilation louvers or heat sinks.
 - b. Door mounted analog or digital speed indicator calibrated 0-100%.
 - c. Power on light.
 - d. Fault light.
 - e. Fault reset button.
 - f. Manual speed potentiometer for operation in the manual mode.
 - g. Manual-off-automatic switch.
 - h. Manually switched bypass circuit to bypass power feed around the inverter.
 - i. Temperature controlled cooling fan.
- D. Unit to include automatic restart circuitry in the event of a power outage, with no more than a 60 second delay after power is reapplied. Unit shall try at least three re-starts before shut-down and alarm.
- E. Environmental Ratings
 1. The VFD shall be designed to operate in a pollution Degree-2 environment. The VFD shall meet IEC 664-1 and NEMA ICS 1 Standards.
 2. The storage temperature range shall be -25° C to 70° C (-13° F to 158° F).
 3. The maximum relative humidity shall be 95% at 40° C (104° F), non-condensing.
 4. The VFD shall be rated to operate at altitudes less than or equal to 3,300 ft (1000m). For altitudes above 3,300 ft (1,000 m), de-rate the VFD by 1.2% for every 330 ft (100m).
 5. The VFD shall meet the IEC 68-2 operational vibration specification.
- F. Performance Ratings
 1. The VFD shall be designed to operate ($\pm$) 10% of rated voltage
 2. The VFD shall operate from an input frequency range of 47.5 to 63-Hz.
 3. The displacement power factor shall not be less than 0.95 lagging under any speed or load condition.
 4. The efficiency of the VFD at 100% speed and load shall not be less than 96%.
 5. The variable torque rated VFD over current capacity shall be not less than 110 % for 1-minute.
 6. The output carrier frequency of the VFD shall be programmable at 2, 4 or 10-kHz. In addition, the output carrier frequency shall be randomly modulated about the selected frequency. VFDs with an operable carrier frequency above 10-kHz shall not be allowed.
 7. Provide with temperature controlled cooling fans.
- G. Protection
 1. Upon power-up, the VFD shall automatically test for valid operation of memory, loss of analog reference input, loss of communication, DC-to-DC power supply, control power and pre-charge circuit.
 2. The VFD shall be UL 508A or 508C listed for the available fault as determined available by the designer, but no less than 22,000-A rms fault current for 460 V drives. For 208-VAC distribution systems, the UL508C listing shall be for 8,800-A rms of minimum

- available fault current. The Power Converter shall meet the short circuit specifications defined by NEMA ICS 7.1.09, and have the value listed on the VFD nameplate.
3. The VFD shall be protected against short circuits between output phases and to ground.
 4. The VFD shall have a minimum AC under voltage power loss ride-through of 200 milliseconds (12 cycles).
 5. The VFD shall have a programmable ride through function which will allow the logic to maintain control for a minimum of one second (60 cycles) without faulting.
 6. For a fault condition other than a ground fault, short circuit or internal fault, an auto restart function will provide up to 5 programmable restart attempts. The programmable time delay before restart attempts will range from 1 second to 600 seconds.
 7. Upon loss of the analog input speed reference signal, the VFD shall fault and / or operate at a user-defined speed set between programmed low- and high-speed settings.
 8. The VFD shall include solid-state protection that is UL listed and that meets UL 508 C as a Class 10 overload protective device and meets IEC 947. The minimum adjustment range shall be from .45 to 1.05% of the current output of the VFD.
 9. The output frequency shall be software -controlled to reduce frequency (fold back) when the motor is overloaded.
 10. There shall be three skip frequency ranges that can each be programmed to a bandwidth of 2 or 5 Hz. The skip frequencies shall be programmed independently, back to back, or overlapping.
 11. For motors 5 hp and larger provide Shaft Grounding Rings, to protect the motors against VFD induced damage such as motor bearing failure.
 12. The VFD shall include 'output phase imbalance' fault indication.
 13. The VFD shall include DC link reactors to minimize power line harmonics and to provide near unity power factor.

H. Adjustments & Configurations

1. The VFD will be factory programmed to operate all specified optional devices.
2. The acceleration and deceleration ramp times shall be adjustable from 1 to 999 seconds.
3. The memory shall retain and record run status and fault type of the past 8 faults.
4. The software shall have a no load function that, when selected, will reduce the voltage to the motor for variable torque loads. A constant volts/Hz ratio will be maintained during acceleration. The output voltage will then automatically adjust to meet the torque requirement of the load.
5. Provide a programmable Automatic Energy Optimization (AEO) selection feature to optimize motor magnetization voltage and minimize energy consumption in variable torque applications. This feature should dynamically and continuously adjust output voltage in response to load, independent of speed.
6. Provide an Automatic Motor Adaptation (AMA) function measuring motor stator resistance and reactance to optimize performance and efficiency. It shall not be necessary to spin the motor shaft or decouple the motor from the load to accomplish this optimization. Additionally, the parameters for motor resistance and motor reactance shall be user-programmable.

I. Keypad Display Interface

1. The keypad display interface shall enable adjustments to the VFD via a touch keypad. All electrical values, configuration parameters, I/O assignments, application and activity function access, faults, local control, adjustment storage, self-test and diagnostics shall be in plain English.
2. The display will be a high resolution, LCD back-lit screen capable of displaying graphics such as bar graphs as well as six lines of 21 alphanumeric characters.
3. The VFD model number, torque type, software revision number, horsepower, output current, motor frequency and motor voltage shall be listed on the drive identification portion of the LCD display.
4. The keypad display shall be configured to display one or two bar graphs with numeric data that are programmable by the operator. As a minimum the programmable outputs shall consist of speed reference, output frequency, output current, motor torque, output power, output voltage, line voltage, DC voltage, motor thermal state, drive thermal state, elapsed time, motor speed, machine speed reference and machine speed.
5. The keypad display shall consist of programmable function keys that allow both operating commands and programming options to be preset by the operator. A hardware selector switch shall allow the terminal keypad to be locked out from unauthorized personnel.
6. A RUN key and a STOP key will command a normal starting and stopping as programmed when the VFD is in keypad control mode. The STOP key must be active in all control modes.
7. The VFD shall have three LEDs mounted on the front panel to indicate functional status. A green LED will verify that the VFD power supply is on. A red LED indicator will indicate an VFD fault. A yellow LED indicator will designate a pending fault condition.

J. Operator Control Interface

1. The control power for the digital inputs and outputs shall be 24 VDC.
2. The internal power supply shall incorporate automatic current fold-back that protects the internal power supply if incorrectly connected or shorted. The transistor logic outputs will be current limited and will not be damaged if shorted.
3. Pull-apart terminal strips shall be used on all logic and analog signal connections in the power converter.
4. Input requirements; four isolated digital logic inputs and two isolated analog inputs (one 0 - 10VDC speed potentiometer and one 4-20mA speed reference).
5. Output requirements; two digital logic outputs, two voltage-free relay output contacts (fault status and a programmable drive run), and two isolated 4 – 20 mA analog outputs that can be selected and assigned in the software (and be proportional to the following motor characteristics: frequency, current, power torque, voltage and thermal state).
6. The combination enclosure shall have the following dedicated operator controls:
 - a. Hand-Off-Auto switch
 - b. Manual Speed Potentiometer
 - c. VFD-Off-Bypass switch
7. The hands-off-auto function which provides seamless transfer from EMCS control to hand control and back, without interruption of motor speed on transfer...The optional

- 120 VAC smoke purge relay shall be installed in the combination enclosure, and shall enable the VFD to be sequenced in accordance with local fire protection codes. A user-supplied 120 VAC signal will switch the VFD to 60 Hz operation for maximum fan motor speed. If drive bypass is supplied, the smoke purge relay will isolate the VFD and run the fan motor full speed on bypass .
8. The combination enclosure shall also include terminal point connection for fire /freeze stat interlock, to prevent drive or bypass [if supplied] operation.
 9. VFDS shall be furnished with a LonTalk compatible FTT-10A compatible transceiver Drive / Bypass Contractors
 10. VFS with bypass mode shall a drive disconnect, a two contactor bypass for full speed operation, and isolation barriers between the VFD and bypass. Specify VFD's with bypass when installed on fan motors.
 11. The combination enclosure shall include a pair of IEC rated bypass contactors (complete with thermal overload relays) to isolate the VFD output during the bypass mode and to coincidentally provide line power directly to the motor. It shall also include fuses on the line side of the VFD to enable isolation, a circuit breaker disconnect, control circuit transformer, motor flux decay timer and VFD/OFF/BYPASS switch. The operator shall have full control of the bypass contactors by operation of the combination enclosure mounted selector switch.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's written installation instructions.
- B. Install line filters where required by manufacturer's recommendations.
- C. Cabling from the drive to the motor shall consist of three (3) stranded copper TC circuit conductors with XLPE insulation. Shielding shall be provided consisting of two spiral copper tape shields (100% coverage). Provide with three (3) full size bare copper grounds.
- D. The contractor shall assume the responsibility for coordinating the purchased equipment with the motor served and with the automatic temperature control system, paying specific attention to the signal sent and received the ground source and the required speed range.
- E. Start-up shall be by a factory trained field service engineer representing the manufacturer of the equipment purchased. Start-up shall be done in the presence of the controls contractor and the engineer.
- F. Training: A one-day on-site training course shall be provided by a representative of the VFD manufacturer to plant and/or maintenance personnel.
- G. Documentation: The VFD manufacturer shall supply a comprehensive 8-1/2" x 11" spiral bound instruction-installation manual that includes wiring diagrams and layout.

END OF SECTION 230975

SECTION 232113 - HYDRONIC PIPING

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 pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
 - 1. Chilled-water piping.
 - 2. Hot-water piping
 - 3. Condensate piping
- B. See Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.

1.3 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
 - 1. Chilled-Water Piping: 250 psig at 200 deg F (93 deg C)
 - 2. Hot Water Piping: 250 psig at 200 deg F (93 deg C)

1.4 SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Pressure-seal fittings.
 - 2. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
 - 3. Air control devices.
 - 4. Hydronic specialties.
- B. Shop Drawings: Detail, at 1/4 (1:50) scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.5 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B).
- B. Wrought-Copper Unions: ASME B16.22.

2.2 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.
- B. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications" Article.
- C. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - 1. Material Group: 1.1.
 - 2. End Connections: Butt welding.
 - 3. Facings: Raised face.
- D. Slip-On flanges are not permitted.
- E. All piping shall comply with ASTM A105.

2.3 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASTM A307A bolts or studs only.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

- D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
- E. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.
- F. Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- G. Insulating Material: Suitable for system fluid, pressure, and temperature.
- H. Dielectric Unions:
 - 1. Not Permitted; use Dielectric nipples or bronze ball valve to connect dissimilar metals.
- I. Dielectric Couplings:
 - 1. Galvanized-steel coupling with inert and noncorrosive thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

2.4 VALVES

- A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."
- B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Instrumentation and Control for HVAC."
- C. Bronze, Calibrated-Orifice, Balancing Valves:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong Pumps, Inc.
 - b. Bell & Gossett Domestic Pump; a division of ITT Industries.
 - c. Flow Design Inc.
 - d. Gerand Engineering Co.
 - e. Griswold Controls.
 - f. Taco.
 - g. Tour & Andersson; available through Victaulic Company of America
 - 2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
 - 3. Ball: Brass or stainless steel.
 - 4. Plug: Resin.
 - 5. Seat: PTFE.
 - 6. End Connections: Threaded or socket.
 - 7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 - 8. Handle Style: Lever, with memory stop to retain set position.
 - 9. CWP Rating: Minimum 125 psig (860 kPa).

10. Maximum Operating Temperature: 250 deg F (121 deg C).

D. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong Pumps, Inc.
 - b. Bell & Gossett Domestic Pump; a division of ITT Industries.
 - c. Flow Design Inc.
 - d. Gerand Engineering Co.
 - e. Griswold Controls.
 - f. Taco.
2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Stem Seals: EPDM O-rings.
5. Disc: Glass and carbon-filled PTFE.
6. Seat: PTFE.
7. End Connections: Flanged or grooved.
8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
9. Handle Style: Lever, with memory stop to retain set position.
10. CWP Rating: Minimum 125 psig (860 kPa).
11. Maximum Operating Temperature: 250 deg F (121 deg C).

2.5 AIR CONTROL DEVICES

- 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:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Amtrol, Inc.
 2. Armstrong Pumps, Inc.
 3. Bell & Gossett Domestic Pump; a division of ITT Industries.
 4. Taco.
- C. Manual Air Vents:
 1. Body: Bronze.
 2. Internal Parts: Nonferrous.
 3. Operator: Screwdriver or thumbscrew.
 4. Inlet Connection: NPS 1/2 (DN 15).
 5. Discharge Connection: NPS 1/8 (DN 6).
 6. CWP Rating: 150 psig (1035 kPa).
 7. Maximum Operating Temperature: 225 deg F (107 deg C).

D. Expansion Tanks:

1. Tank: Welded steel, rated for 125-psig (860-kPa) working pressure and 375 deg F (191 deg C) maximum operating temperature, with taps in bottom of tank for tank fitting and taps in end of tank for gage glass. Tanks shall be factory tested with taps fabricated and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Air-Control Tank Fitting: Cast-iron body, copper-plated tube, brass vent tube plug, and stainless-steel ball check, 100-gal. (379-L) unit only; sized for compression-tank diameter. Provide tank fittings for 125-psig (860-kPa) working pressure and 250 deg F (121 deg C) maximum operating temperature.
3. Tank Drain Fitting: Brass body, nonferrous internal parts; 125-psig (860-kPa) working pressure and 240 deg F (116 deg C) maximum operating temperature; constructed to admit air to compression tank, drain water, and close off system.

E. In-Line Air Separators:

1. Tank: One-piece cast iron with an integral weir constructed to decelerate system flow to maximize air separation.
2. Maximum Working Pressure: Up to 175 psig (1207 kPa).
3. Maximum Operating Temperature: Up to 300 deg F (149 deg C).

2.6 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig (860 kPa).

B. Stainless-Steel Bellow, Flexible Connectors:

1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch (20-mm) misalignment.
4. CWP Rating: 150 psig (1035 kPa).
5. Maximum Operating Temperature: 250 deg F (121 deg C).

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Chilled-water piping, aboveground, NPS 1 (DN 50) and smaller, shall be any of the following:

1. Type L (B), drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

2. Schedule 40 steel pipe; Class 250, malleable-iron fittings; malleable-iron flanges and flange fittings; and threaded joints.
- B. Chilled-water piping, aboveground, NPS 1 to NPS 2, shall be any of the following:
 1. Type L (B), drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
 2. Schedule 40 steel pipe; Class 250, malleable-iron fittings; malleable-iron flanges and flange fittings; and threaded joints.
- C. Chilled-water piping, aboveground, NPS 2-1/2 (DN 65) and larger, shall be the following:
 1. Schedule 40 steel pipe; Class 250, malleable-iron fittings; malleable-iron flanges and flange fittings.
- D. Hot-water piping, aboveground, NPS 1 (DN 50) and smaller, shall be any of the following:
 1. Type L (B), drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
 2. Schedule 40 steel pipe; Class 250, malleable-iron fittings; malleable-iron flanges and flange fittings; and threaded joints.
- E. Hot-water piping, aboveground, NPS 1 to NPS 2, shall be any of the following:
 1. Type L (B), drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
 2. Schedule 40 steel pipe; Class 250, malleable-iron fittings; malleable-iron flanges and flange fittings and threaded joints.
- F. Hot-water piping, aboveground, NPS 2-1/2 (DN 65) and larger, shall be the following:
 1. Schedule 40 steel pipe; Class 250, malleable-iron fittings; malleable-iron flanges and flange fittings.
- G. Condensate piping, aboveground, shall be the following:
 1. Drawn-Temper Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B).

3.2 DIRECT BURIED PIPING SYSTEM

1. General: All underground piping for chilled water system distribution shall have a minimum diameter of 4" and shall be cement lined ductile iron.
2. Pipe Joint Restraint Calculations: Submit complete calculations for underground chilled water pipe joints indicating the requirements for restrained and push-on joints. Submission of output data from an approved vendor computer selection/calculation program will be required to justify the use of push-on joints in certain locations. This program shall utilize the depth of cover indicated on the profile drawings.
3. Ductile Iron Pipe: Pipe shall conform to AWWA C151 minimum class 50. All ductile iron pipe shall be cement mortar lined in accordance with AWWA C104 and shall have asphaltic coating. Piping 4" – 12" shall have 350 psig minimum working pressure. Piping 14" – 24" shall have a 300 psig minimum working pressure.
4. Select backfill material shall be provided for bedding and backfill 12" above pipe.

5. System drains and vents – Provide system drains at low points and system vents at high points according to details as attached.
6. Fittings: Fittings for ductile iron pipe shall be ductile iron and rated a minimum of 250 psi working pressure. Fittings shall be cement mortar lined equivalent to the pipe lining.
7. Mechanical Joint Fittings: Comply with AWWA C110. Where restrained joints are identified, use Megalug Series 1100 system or approved equal. Gasket material shall be SBR
8. Push-on Joint: Comply with AWWA C111
9. Butterfly Valves: Comply with AWWA C504. Valve shaft to be type 304 stainless steel. Cast valves from gray or ductile iron. Provide interior coating of body and disk. Valves shall be furnished with buried service gearbox operator, shaft extensions, ground level position indicators and valve boxes.
10. Gate Valves: Comply with AWWA C509. Stem shall be non-rising and shall be cast bronze. Valve body and wedge shall be ductile iron and shall be coated inside and outside with epoxy. The coating shall meet or exceed AWWA C550. Valves shall have a minimum pressure rating of 250 psi. Gate valves shall be US pipe or approved equal.
11. Valve Boxes: Valve boxes shall be 2 piece cast iron with heavy duty traffic weight lid marked with valve number as shown on drawings (such as CWS –22). Valve boxes not in paving shall be supplied with a pre-cast concrete mowing ring.

3.3 VALVE APPLICATIONS

- A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.
- B. Install calibrated-orifice, balancing valves at each branch connection to return main.
- C. Install calibrated-orifice, balancing valves in the return pipe of each heating terminal as indicated.
- D. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.
- F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.
- G. Brazed fittings for copper pipes.

3.4 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

- B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Use ASTM A307 A Bolts and nuts.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- M. Install drains, consisting of a tee fitting or thread-o-let, NPS 3/4 (DN 20) ball valve, and short NPS 3/4 (DN 20) threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage. Piping nipple shall be long enough to clear insulation.
- N. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- O. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- P. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- Q. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."
- R. Install unions in piping, NPS 2 (DN 50) and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- S. Install flanges in piping, NPS 2-1/2 (DN 65) and larger, at final connections of equipment and elsewhere as indicated.
- T. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 (DN 20) nipple and ball valve in

blowdown connection of strainers NPS 2 (DN 50) and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2 (DN 50).

- U. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."
- V. Arrange piping to minimize the occurrences of dielectric connections.

3.5 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.
- B. Support vertical runs at roof, at each floor, and at 10-foot (3-m) intervals between floors.

3.6 PIPE JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.7 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

- B. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
- C. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 (DN 50) and larger.
- D. Install bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than 48 inches (1200 mm) above the floor. Install feeder in minimum NPS 3/4 (DN 20) bypass line, from main with full-size, full-port, ball valve in the main between bypass connections. Install NPS 3/4 (DN 20) pipe from chemical feeder drain, to nearest equipment drain and include a full-size, full-port, ball valve.
- E. Install expansion tanks above the air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.
 - 1. Install tank fittings that are shipped loose.
 - 2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.

3.8 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 23 Section "Meters and Gages for HVAC Piping."

3.9 CHEMICAL TREATMENT

- A. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.
- B. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.

3.10 FLUSHING & CLEANING PIPING SYSTEMS GENERAL

- A. All water used during the hydrostatic pressure tests, cleaning, flushing and filling of piping systems shall be provided by the contractor and included in the project cost unless specifically agreed upon by the Director of Utilities and Engineering Services. This water is to be metered from project beginning until the piping system is cleared to be connected to the campus utility systems and/or at project close-out
- B. Flush all water systems thoroughly for a minimum of 1 hour or longer, as required, to ensure removal of all dirt and foreign matter from piping system. Flushing shall continue until water

draining from the pipe is clear and clean of any dirt and debris as determined by the Engineer or Owner and verified by the NCSU Utilities Distribution Shop. Bypass all pumps and equipment and remove all strainers from strainer bodies. Provide circulation by Contractor supplied pumping apparatus

- C. Contractor shall be responsible for phasing and scheduling piping installation work such that all sections of the new piping will be cleaned and flushed as specified. Contractor shall provide temporary access tapping at all high points and low points through valves, tees, flanges, etc. to facilitate the cleaning and flushing process.
- D. Contractor shall provide all water for flushing. Coordinate rental of fire hydrant meters with the City of Raleigh or NCSU Utilities Distribution, as determined by the Project Manager and based on hydrant system owner (NCSU or City of Raleigh).
- E. Contractor shall provide all temporary piping from water source to piping system and shall provide means for conducting testing and cleaning water from underground piping system to the appropriate sewer; i.e. pumps, piping, hoses, etc. Contractor to remove all temporary piping, pumps, hoses, etc. from the site after flushing has been completed.
- F. Provide temporary piping or hose to bypass coils, control valves, heat exchangers, other factory cleaned equipment, and any component which may be damaged, unless acceptable means of protection are provided and subsequent inspection of hide-out areas takes place.
- G. Sectionalize system to obtain minimum velocity of 6 fps. Provide temporary piping to connect dead-end supply and return headers as necessary. Flush bottom of risers.
- H. Coordinate with NCSU Utilities Distribution personnel to visually inspect piping systems as installed and/or flushed to verify cleanliness from the owner's perspective.
- I. Add chemical inhibitor Nalco 8338 or equivalent to closed loop water systems. (see below)
- J. Provide NCSU Utilities & Engineering (Water Treatment Technician) with records of flushing, treating chemicals (quantities and concentrations) and final water chemistry.
- K. Contractor shall be responsible for filling and treating water for final fill.

3.11 FLUSHING & CLEANING PIPING SYSTEMS FINAL

- A. Flush all water thoroughly for a minimum of 1 hour or longer, as required, to ensure removal of all dirt and foreign matter from piping system. Flushing shall continue until water draining from the pipe is clear and clean of any dirt and debris as determined by the Engineer or Owner and verified by the NCSU Utilities Distribution Shop. Bypass all pumps and equipment and remove all strainers from strainer bodies. Provide circulation by Contractor supplied pumping apparatus.
- B. After initial flushing of system discussed in paragraph A above, use portable pumping apparatus for continuous 24 hour minimum circulation of cold water detergent similar to Nalco 2567 cleaner. Flush detergent clear with continuous draining and raw water fill for additional 12 to 24 hours or until all cleaner is removed from system and conductivity, pH, and

iron concentrations are within guidelines and verified by the NCSU Water Treatment Technician. Replace strainers and reconnect permanent pumping apparatus and all apparatus bypassed.

3.12 WATER ANALYSIS REQUIREMENTS

- A. Specific numbers will be determined at the time of construction as city water and system values can vary from location to location within the NCSU campus.
- B. Hot Water Piping:
 - 1. Conductivity: Approximate existing system conditions
 - 2. pH: Approximate existing system conditions
 - 3. Target inhibitor PPM level: Approximate existing system conditions
 - 4. Iron concentration: Approximate existing City of Raleigh water conditions

3.13 SYSTEM PRESSURE AND LEAK TEST

- A. Length of test, unless otherwise approved, shall be a minimum of 4 hours. Contractor shall have conducted a preliminary pressure test prior to final acceptance test to locate and correct any pipe leaks.
- B. Water piping shall be leakage rate tested. Leakage rate test shall be conducted at the same time as the hydrostatic pressure test. Leakage rate is defined as the quantity of water that must be supplied into respective underground piping system to maintain pressure within 5 psig of the specified hydrostatic test pressure after system has been vented and filled. Contractor shall document test results and sign/date each test.
- C. The maximum allowable leakage is determined by the following formula
 - 1. $L = N \cdot D \cdot (P)^{2/3} / 7,400$
where:
L = allowable leakage (GPH)
N = number of joints in length of pipe line tested
D = nominal pipe diameter (inches)
P = average test pressure during leakage test (psig)
 - 2. If measure leakage rate exceeds maximum leakage rate, repair with new materials and repeat test until satisfactory results have been obtained.

3.14 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.

3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:
1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 3. Isolate expansion tanks and determine that hydronic system is full of water.
 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
 5. After hydrostatic test pressure has been applied for at least 16 hours, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
 6. Prepare written report of testing.
- C. Perform the following before operating the system:
1. Open manual valves fully.
 2. Inspect pumps for proper rotation.
 3. Set makeup pressure-reducing valves for required system pressure.
 4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 5. Set temperature controls so all coils are calling for full flow.
 6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
 7. Verify lubrication of motors and bearings.

END OF SECTION 232113

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SECTION 233113 - METAL DUCTS

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. Rectangular ducts and fittings.
 - 2. Round ducts and fittings.
 - 3. Sheet metal materials.
 - 4. Sealants and gaskets.
 - 5. Hangers and supports.

1.3 PERFORMANCE REQUIREMENTS

- A. Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated.
 - 1. Static-Pressure Classes:
 - a. Supply Ducts (Upstream from Air Terminal Units): 4-inch wg (500 Pa)
 - b. Supply Ducts (Downstream from Air Terminal Units): 2-inch wg (250 Pa)
 - c. Return Ducts (Negative Pressure): 2-inch wg (250 Pa)
 - d. Exhaust Ducts (Negative Pressure): 1-inch wg (250 Pa)
 - 2. Leakage Class:
 - a. Round Supply-Air Duct: 3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m at 250 Pa)
 - b. Rectangular Supply-Air Duct: 6 cfm/100 sq. ft. at 1-inch wg (0.29 L/s per sq. m at 250 Pa)
 - c. Flexible Supply-Air Duct: 6 cfm/100 sq. ft. at 1-inch wg (0.29 L/s per sq. m at 250 Pa)
- B. Duct performance shall be demonstrated to engineer and owner for all new ductwork installed to be in compliance with requirements above.
 - 1. Leakage test shall be a dual-manometer type.
 - 2. Leakage rates shall be calculated by contractor based upon fan curves
 - 3. No new ductwork may be insulated until leakage test has been performed and approved by engineer.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 - 2. Factory- and shop-fabricated ducts and fittings.
 - 3. Duct layout indicating sizes, configuration, and static-pressure classes.
 - 4. Elevation of top of ducts.
 - 5. Dimensions of main duct runs from building grid lines.
 - 6. Fittings.
 - 7. Reinforcement and spacing.
 - 8. Seam and joint construction.
 - 9. Penetrations through fire-rated and other partitions.
 - 10. Equipment installation based on equipment being used on Project.
 - 11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
 - 12. Hangers and supports, including methods for duct and building attachment, and vibration isolation.
 - 13. Paint color samples.
- C. Delegated-Design Submittal:
 - 1. Sheet metal thicknesses.
 - 2. Joint and seam construction and sealing.
 - 3. Reinforcement details and spacing.
 - 4. Materials, fabrication, assembly, and spacing of hangers and supports.
- D. Coordination Drawings: 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. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
 - 2. Suspended ceiling components.
 - 3. Structural members to which duct will be attached.
 - 4. Size and location of initial access modules for acoustical tile.
 - 5. Penetrations of smoke barriers and fire-rated construction.
 - 6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Perimeter moldings.

- E. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 - 2. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

PART 2 - PRODUCTS

2.1 RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Lindab Inc.
 - b. McGill AirFlow LLC.
 - c. SEMCO Incorporated.

- d. Sheet Metal Connectors, Inc.
 - e. Spiral Manufacturing Co., Inc.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Transverse Joints in Ducts Larger Than 60 Inches (1524 mm) in Diameter: Flanged.
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Fabricate round ducts larger Than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90 (Z275).
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- D. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.4 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
 - 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 - 2. Tape Width: 4 inches (102 mm).
 - 3. Sealant: Modified styrene acrylic.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
 - 7. Service: Indoor and outdoor.
 - 8. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).
 - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
- C. Water-Based Joint and Seam Sealant:
 - 1. Application Method: Brush on.
 - 2. Solids Content: Minimum 65 percent.
 - 3. Shore A Hardness: Minimum 20.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. VOC: Maximum 75 g/L (less water).
 - 7. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
 - 8. Service: Indoor or outdoor.
 - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Flanged Joint Sealant: Comply with ASTM C 920.
 - 1. General: Single-component, acid-curing, silicone, elastomeric.
 - 2. Type: S.
 - 3. Grade: NS.
 - 4. Class: 25.
 - 5. Use: O.
- E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- F. Round Duct Joint O-Ring Seals:
 - 1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m at 250 Pa) and shall be rated for 10-inch wg (2500-Pa) static-pressure class, positive or negative.

2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.5 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1 (Table 4-1M), "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- G. Trapeze and Riser Supports:
 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches (38 mm).
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

3.2 SEAM AND JOINT SEALING

- A. Seal duct seams and joints for duct static-pressure and leakage classes specified in "Performance Requirements" Article, according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements," unless otherwise indicated.

3.3 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
 - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1 (Table 4-1M), "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.

- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet (5 m).
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- G. Drilling for and Setting Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.4 STORAGE AND HANDLING

- A. All duct arriving on site shall be externally wrapped.
- B. Duct stored on site shall be installed with un-attached end wrapping.
- C. Ductwork that is determined dirty by the engineer of record shall be cleaned at the cost of the GC.

3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 DUCT SCHEDULE

- A. Square Duct, Interior -Supply, Exhaust, Return.
 - 1. Exposed: Galvanized, welded joints, paint color by Architect.
 - 2. Concealed: Galvanized, Flanged joints.

- B. Round Duct, Interior Supply, Exhaust, Return.
 - 1. Exposed: Galvanized, spiral, welded joints, paint color by Architect.
 - 2. Concealed: Galvanized, Flanged joints.
 - 3. Acid-Resistant (Fume-Handling) Ducts:
 - a. Type 304, stainless-steel sheet.
 - b. Exposed to View: No. 3 finish.
- C. Square Duct, Exterior -Supply, Exhaust, Return.
 - 1. Galvanized, flanged joints.
 - 2. Acid-Resistant (Fume-Handling) Ducts:
 - a. Type 304, stainless-steel sheet.
 - b. Exposed to View: No. 3 finish.
- D. Intermediate Reinforcement:
 - 1. Galvanized-Steel Ducts: Galvanized steel.
- E. Elbow Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm (5 m/s) or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.
 - b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s):
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
 - c. Velocity 1500 fpm (7.6 m/s) or Higher:
 - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1000 fpm (5 m/s) or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm (5 to 7.6 m/s): 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm (7.6 m/s) or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - b. Round Elbows, 12 Inches (305 mm) and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches (356 mm) and Larger in Diameter: Standing seam.

F. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.
2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm (5 m/s) or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Conical tap.
 - c. Velocity 1500 fpm (7.6 m/s) or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233300 - AIR DUCT 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. Backdraft and pressure relief dampers.
 - 2. Barometric relief dampers.
 - 3. Manual volume dampers.
 - 4. Control dampers.
 - 5. Fire dampers.
 - 6. Flange connectors.
 - 7. Turning vanes.
 - 8. Duct-mounted access doors.
 - 9. Flexible connectors.
 - 10. Duct accessory hardware.

1.3 SUBMITTALS

- A. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
 - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.
 - c. Control damper installations.
 - d. Fire-damper, combination fire- and smoke-damper, including sleeves; and duct-mounted access doors and remote damper operators.
 - e. Wiring Diagrams: For power, signal, and control wiring.
- B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.
- C. Source quality-control reports.
- D. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

1.5 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90 (Z275).
 - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- D. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Greenheck Fan Corporation.
 - 2. Nailor Industries Inc.
 - 3. NCA Manufacturing, Inc.
 - 4. Pottorff; a division of PCI Industries, Inc.
 - 5. Ruskin Company.
- B. Description: Gravity balanced
- C. Maximum Air Velocity: 2000 fpm (10 m/s)

- D. Maximum System Pressure: 5-inch wg (0.25 kPa)
- E. Frame: 0.063-inch- (1.6-mm-) thick extruded aluminum.
- F. Blades: Multiple single-piece blades, maximum 6-inch (150-mm) width, 0.025-inch- (0.6-mm-) thick, roll-formed aluminum with sealed edges.
- G. Blade Action: Parallel.
- H. Blade Seals: Neoprene, mechanically locked.
- I. Blade Axles:
 - 1. Material: Galvanized steel.
 - 2. Diameter: 0.20 inch (5 mm)
- J. Tie Bars and Brackets: Galvanized steel.
- K. Return Spring: Adjustable tension.
- L. Bearings: Steel ball.
- M. Accessories:
 - 1. Adjustment device to permit setting for varying differential static pressure.
 - 2. Counterweights and spring-assist kits for vertical airflow installations.
 - 3. Electric actuators.
 - 4. Chain pulls.
 - 5. Front of rear screens.
 - 6. 90-degree stops.
- N. Sleeve: Minimum 20-gage (1.0-mm) thickness.

2.3 BAROMETRIC RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Greenheck Fan Corporation.
 - 2. Nailor Industries Inc.
 - 3. NCA Manufacturing, Inc.
 - 4. Pottorff; a division of PCI Industries, Inc.
 - 5. Ruskin Company.
- B. Suitable for horizontal or vertical mounting.
- C. Maximum Air Velocity: 2000 fpm (10 m/s).
- D. Maximum System Pressure: 5-inch wg (0.5 kPa).

- E. Frame: 0.064-inch- (1.6-mm-) thick, galvanized sheet steel, with welded corners and mounting flange.
- F. Blades:
 - 1. Multiple, 0.025-inch- (0.6-mm-) thick, roll-formed aluminum.
 - 2. Maximum Width: 6 inches (150 mm).
 - 3. Action: Parallel.
 - 4. Balance: Gravity.
 - 5. Eccentrically pivoted.
- G. Blade Seals: Neoprene.
- H. Blade Axles: Galvanized steel.
- I. Tie Bars and Brackets:
 - 1. Material: Galvanized steel.
 - 2. Rattle free with 90-degree stop.
- J. Return Spring: Adjustable tension.
- K. Bearings: Stainless steel.
- L. Accessories:
 - 1. Flange on intake.
 - 2. Adjustment device to permit setting for varying differential static pressures.

2.4 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. METALAIRE, Inc.
 - c. Nailor Industries Inc.
 - d. Pottorff; a division of PCI Industries, Inc.
 - e. Ruskin Company.
 - 2. Standard leakage rating.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames:
 - a. Hat-shaped, galvanized-steel channels, 0.064-inch (1.62-mm) minimum thickness.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized-steel, 0.064 inch (1.62 mm) thick.
6. Blade Axles: Galvanized steel.
7. Bearings:
 - a. Stainless-steel sleeve.
 - b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
8. Tie Bars and Brackets: Galvanized steel.

B. Jackshaft:

1. Size: 1-inch (25-mm) diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

C. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- (2.4-mm-) thick zinc-plated steel, and a 3/4-inch (19-mm) hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.5 CONTROL DAMPERS

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

1. Duro Dyne Inc.
2. Flexmaster U.S.A., Inc.
3. Greenheck Fan Corporation.
4. METALAIRE, Inc.
5. Nailor Industries Inc.
6. NCA Manufacturing, Inc.
7. Ruskin Company.

B. Low-leakage rating, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

C. Frames:

1. Angle shaped.
2. Galvanized-steel channels, 0.064 inch (1.62 mm) thick.
3. Mitered and welded corners.

D. Blades:

1. Multiple blade with maximum blade width of 8 inches (200 mm).
2. Opposed-blade design.
3. Galvanized Stainless steel.
4. 0.064 inch (1.62 mm) thick.
5. Blade Edging: Closed-cell neoprene edging.

E. Blade Axles: 1/2-inch- (13-mm-) diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

1. Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).

F. Bearings:

1. Oil-impregnated bronze.
2. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
3. Thrust bearings at each end of every blade.

2.6 FIRE DAMPERS

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

1. Greenheck Fan Corporation.
2. METALAIRE, Inc.
3. Nailor Industries Inc.
4. NCA Manufacturing, Inc.
5. Pottorff; a division of PCI Industries, Inc.
6. Prefco; Perfect Air Control, Inc.
7. Ruskin Company.

B. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.

C. Closing rating in ducts up to 5-inch wg static pressure class and minimum 4000-fpm (20-m/s) velocity.

D. Fire Rating: 1-1/2] hours.

E. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.052 or 0.138 inch (1.3 or 3.5 mm) thick, as indicated, and of length to suit application.
2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Roll-formed, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized-steel blade connectors.

I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

J. Heat-Responsive Device: Replaceable, 165 deg F (74 deg C) rated, fusible links.

2.7 FLANGE CONNECTORS

A. Description: Roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

B. Material: Galvanized steel.

C. Gage and Shape: Match connecting ductwork.

2.8 TURNING VANES

A. Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

B. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."

D. Vane Construction: Single wall.

E. Vane Construction: Single wall for ducts up to 48 inches (1200 mm) wide and double wall for larger dimensions.

2.9 DUCT-MOUNTED ACCESS DOORS

- A. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."
 - 1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Vision panel.
 - d. Hinges and Latches: 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.
 - e. Fabricate doors airtight and suitable for duct pressure class.
 - 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 - 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches (300 mm) Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches (460 mm) Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches (600 by 1200 mm): Three hinges and two compression latches.
 - d. Access Doors Larger Than 24 by 48 Inches (600 by 1200 mm): Four hinges and two compression latches with outside and inside handles.

2.10 FLEXIBLE CONNECTORS

- A. Materials: Flame-retardant or noncombustible fabrics.
- B. Coatings and Adhesives: Comply with UL 181, Class 1.
- C. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
 - 2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.
 - 3. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).

2.11 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Coordinate subparagraphs below with Division 23 Section "Metal Ducts." Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire dampers according to UL listing.
- H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On both sides of duct coils.
 - 2. Downstream from manual volume dampers, control dampers, and equipment.
 - 3. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - 4. At each change in direction and at maximum 50-foot (15-m) spacing.
 - 5. Upstream of turning vanes.
 - 6. Elsewhere as indicated.
- I. Install access doors with swing against duct static pressure.
- J. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).

2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).
 3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).
 4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).
 5. Body Access: 25 by 14 inches (635 by 355 mm).
 6. Body plus Ladder Access: 25 by 17 inches (635 by 430 mm).
- K. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- L. Install flexible connectors to connect ducts to equipment.
- M. For fans developing static pressures of 5-inch wg (1250 Pa) and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- N. Install duct test holes where required for testing and balancing purposes.
- O. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch (6-mm) movement during start and stop of fans.
- 3.2 FIELD QUALITY CONTROL
- A. Tests and Inspections:
1. Operate dampers to verify full range of movement.
 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 3. Operate fire, dampers to verify full range of movement and verify that proper heat-response device is installed.
 4. Inspect turning vanes for proper and secure installation.

END OF SECTION 233300

SECTION 233600 - AIR TERMINAL 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. This Section includes the following:
 - 1. Dual-duct air terminal units.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated, include rated capacities, furnished specialties, sound-power ratings, and accessories.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Include a schedule showing unique model designation, room location, model number, size, and accessories furnished.
 - 2. Wiring Diagrams: Power, signal, and control wiring.
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Ceiling suspension assembly members.
 - 2. Method of attaching hangers to building structure.
 - 3. Size and location of initial access modules for acoustical tile.
 - 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- D. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data" include the following:
 - 1. Instructions for resetting minimum and maximum air volumes.
 - 2. Instructions for adjusting software set points.

1.4 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of air terminal units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. NFPA Compliance: Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

1.5 COORDINATION

- A. Coordinate layout and installation of air terminal units 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 MANUFACTURERS

Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

- 1. Price Industries.
 - 2. Titus.
 - 3. Carrier
- B. Configuration: Volume-damper assembly inside unit casing with control components located inside a protective metal shroud.
 - C. Casing: 0.034-inch (0.85-mm) steel
 - 1. Casing Lining: Adhesive attached, 3/4-inch- (19-mm-) thick, polyurethane foam insulation complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
 - 2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
 - 3. Air Outlet: S-slip and drive connections, flanged, or collar.
 - 4. Access: Removable panels for access to dampers and other parts requiring service, adjustment, or maintenance; with airtight gasket.
 - 5. Insulated panel, double-clasp access door shall be installed between heating coil and air damper, minimum size 8x8.
 - 6. Install access door on bottom of unit and locate between the volume damper and the reheat coil.
 - D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
 - 1. Maximum Damper Leakage: ARI 880 rated, 1 percent of nominal airflow at 1.5-inch wg inlet static pressure.
 - 2. Damper Position: Last position.

E. Hot-Water Heating Coil:

1. Copper tube, mechanically expanded into aluminum-plate fins; leak tested underwater to 200 psig (1380 kPa); and factory installed.
2. Supply and return piping shall be clearly marked.
3. Minimum 2-row coils.

F. Electric Controls: Controlled by BAS.

2.2 SOURCE QUALITY CONTROL

- A. Identification: Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.
- B. Verification of Performance: Rate air terminal units according to ARI 880.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install air terminal units level and plumb. Maintain sufficient access and clearance for normal service and maintenance.
- B. Contractor shall be requested to demonstrate a full range of maintenance tasks at each installation instance for owner and engineer during above ceiling inspections.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to air terminal units to allow service and maintenance.
- C. Hot-Water Piping: Install per detail.
- D. Connect ducts to air terminal units according to detail.
- E. Provide with local means of disconnect.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.

2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

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

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions and do the following:
 - a. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
 - b. Verify that controls and control enclosure are accessible.
 - c. Verify that control connections are complete.
 - d. Verify that nameplate and identification tag are visible.
 - e. Verify that controls respond to inputs as specified.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air terminal units. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 233600

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Rectangular and square ceiling diffusers.
 - 2. Louver face diffusers.
 - 3. Linear bar diffusers.
 - 4. Linear slot diffusers.
 - 5. Adjustable bar registers and grilles.
 - 6. Fixed face registers and grilles.
 - 7. Linear bar grilles.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Samples: For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

- A. See units specified on drawings
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - a. Anemostat Products; a Mestek company.
 - b. Carnes.
 - c. Hart & Cooley Inc.
 - d. METALAIRE, Inc.
 - e. Nailor Industries Inc.

- f. Price Industries.
- g. Titus.

2.2 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

SECTION 237313 - MODULAR CENTRAL-STATION AIR-HANDLING 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. Variable-air-volume, single-zone air-handling units.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design vibration isolation and seismic-restraint details, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Casing panels shall be self-supporting and capable of withstanding 133 percent of internal static pressures indicated, without panel joints exceeding a deflection of $L/100$ where "L" is the unsupported span length within completed casings.

1.4 SUBMITTALS

- A. Product Data: For each air-handling unit indicated.
 - 1. Unit dimensions and weight.
 - 2. Cabinet material, metal thickness, finishes, insulation, and accessories.
 - 3. Fans:
 - a. Certified fan-performance curves with system operating conditions indicated.
 - b. Certified fan-sound power ratings.
 - c. Fan construction and accessories.
 - d. Motor ratings, electrical characteristics, and motor accessories.
 - 4. Certified coil-performance ratings with system operating conditions indicated.
 - 5. Dampers, including housings, linkages, and operators.
 - 6. Filters with performance characteristics.

- B. Coordination Drawings: Floor plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Mechanical-room layout and relationships between components and adjacent structural and mechanical elements.
 - 2. Support location, type, and weight.
 - 3. Field measurements.
- C. Source quality-control reports.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.
- C. ARI Certification: Air-handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.
- D. Comply with NFPA 70.

1.6 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate sizes and locations of structural-steel support members, if any, with actual equipment provided.

1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filters: Two set(s) for each air-handling unit.
 - 2. Gaskets: One set(s) for each access door.
 - 3. Fan Belts: Two set(s) for each air-handling unit fan.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Carrier Corporation; a member of the United Technologies Corporation Family.
2. Engineered Air.
3. Daikin
4. Trane; American Standard Inc.
5. YORK International Corporation.

2.2 UNIT CASINGS

- A. General Fabrication Requirements for Casings:

1. Forming: Form walls, roofs, and floors with at least two breaks at each joint.
2. Casing Joints: Sheet metal screws or pop rivets.
3. Sealing: Seal all joints with water-resistant sealant.
4. Factory Finish for Steel and Galvanized-Steel Casing.
5. Casing Coating: None
6. Double wall construction.

- B. Casing Insulation and Adhesive:

1. Materials: ASTM C 1071, Type I.
2. Location and Application: Encased between outside and inside casing.

- C. Inspection and Access Panels and Access Doors:

1. Panel and Door Fabrication: Formed and reinforced, single- or double-wall and insulated panels of same materials and thicknesses as casing.
2. Inspection and Access Panels:
 - a. Fasteners: Two or more camlock type for panel lift-out operation. Arrangement shall allow panels to be opened against air-pressure differential.
 - b. Gasket: Neoprene, applied around entire perimeters of panel frames.
 - c. Size: Large enough to allow inspection and maintenance of air-handling unit's internal components.
3. Access Doors:
 - a. Hinges: A minimum of two ball-bearing hinges and two wedge-lever-type latches, operable from inside and outside. Arrange doors to be opened against air-pressure differential.
 - b. Gasket: Neoprene, applied around entire perimeters of panel frames.

- c. Fabricate windows in doors of double-glazed, wire-reinforced safety glass with an air space between panes and sealed with interior and exterior rubber seals.
 - d. Size: At least 24 by 60 inches (600 by 1500 mm).
- 4. Locations and Applications:
 - a. Fan Section: Doors.
 - b. Access Section: Doors.
 - c. Coil Section: Inspection and access panel.
 - d. Damper Section: Doors.
 - e. Filter Section: Doors large enough to allow periodic removal and installation of filters.
- D. Condensate Drain Pans:
 - 1. Fabricated with slopes in at least 2 planes to collect condensate from cooling coils (including coil piping connections, coil headers and return bends, and a minimum of 6 inches (150 mm) downstream from cooling-coil face).
 - 2. Stainless steel construction, with insulated backing.
 - 3. A minimum of 2 inches (50 mm) deep, and complying with requirements in ASHRAE 62.1.
 - 4. Drain Connections: Both ends of pan with NPS 1 (DN 25) threaded nipple.

2.3 FAN, DRIVE, AND MOTOR SECTION

- A. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.
 - 1. Shafts: Designed for continuous operation at maximum-rated fan speed and motor horsepower, and with field-adjustable alignment.
 - a. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.
 - b. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.
- B. Centrifugal Fan Housings: Formed- and reinforced-steel panels to form curved scroll housings with shaped cutoff and spun-metal inlet bell.
 - 1. Bracing: Steel angle or channel supports for mounting and supporting fan scroll, wheel, motor, and accessories.
 - 2. Horizontal-Flanged, Split Housing: Bolted construction.
 - 3. Housing for Supply Fan: Attach housing to fan-section casing with metal-edged flexible duct connector.
 - 4. Flexible Connector: Factory fabricated with a fabric strip 3-1/2 inches (89 mm) wide attached to 2 strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized-steel sheet or 0.032-inch- (0.8-mm-) thick aluminum sheets; select metal compatible with casing.

- C. Airfoil, Centrifugal Fan Wheels: Smooth-curved inlet flange, backplate, and hollow die-formed airfoil-shaped blades continuously welded at tip flange and backplate; cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws.
- D. Fan Shaft Bearings:
 - 1. Prelubricated and Sealed, Ball Bearings: Self-aligning, pillow-block type with a rated life of 250,000 hours according to ABMA 9.
 - 2. Provide automatic oilers if manufacture recommends lubrication more often than every 2000 hrs.
- E. Belt Drives: Factory mounted, with adjustable alignment and belt tensioning, and with 1.5 service factor based on fan motor.
 - 1. Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
 - 2. Motor Pulleys: Adjustable pitch for use with 5-hp motors and smaller; fixed pitch for use with motors larger than 5 hp. Select pulley size so pitch adjustment is at the middle of adjustment range at fan design conditions.
 - 3. Belts: Oil resistant, nonsparking, and nonstatic; in matched sets for multiple-belt drives. Belts and drives shall be equipped with cog type drive belts.
 - 4. Belt Guards: Comply with requirements specified by OSHA and fabricate according to SMACNA's "HVAC Duct Construction Standards"; 0.1046-inch- (2.7-mm-) thick, 3/4-inch (20-mm) diamond-mesh wire screen, welded to steel angle frame; prime coated.
- F. Internal Vibration Isolation: Fans shall be factory mounted with manufacturer's standard restrained]vibration isolation mounting devices having a minimum static deflection of 1 inch (25 mm).
 - 1. Enclosure Type: ODP
 - 2. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 3. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
 - 4. Mount unit-mounted disconnect switches on exterior
- G. Variable Frequency Controllers:
 - 1. Specified in other sections.
- H. Motor: Grease-lubricated ball bearings, unless otherwise indicated; secured to mounting frame, with adjustable alignment. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

2.4 COIL SECTION

- A. General Requirements for Coil Section:

1. Comply with ARI 410.
2. Fabricate coil section to allow removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).
3. Coils shall not act as structural component of unit.
4. Coil sections shall be no higher than 42". Split coils are required over 42"
 - a. Provide interim drain pans for all split coil sections.

B. Coil Construction

1. Minimum of 6 row construction, Maximum of 8 rows.
2. Minimum fouling factor of 0.0005
3. Non-Ferrous headers.
4. Coil casings shall be stainless steel.
5. Coil face area shall be sized for:
 - a. Maximum 550fpm for heating coils
 - b. Maximum 450fpm for cooling coils.
6. Copper tubes:
 - a. Minimum thickness 0.035"
 - b. Minimum tube velocity shall be 4fps at full load conditions.
 - c. Tubing shall be a minimum of 5/8" diameter
7. Aluminum Fins:
 - a. Maximum 10 fins per inch
 - b. Minimum thickness 0.0075"

2.5 AIR FILTRATION SECTION

A. General Requirements for Air Filtration Section:

1. Comply with NFPA 90A.
2. Provide minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
3. Provide filter holding frames arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
4. Provide MERV-13 filtration.

B. Disposable Panel Filters:

1. Factory-fabricated, pleated, throw-away.
2. Thickness: 2 inches (50 mm).
3. Merv (ASHRAE 52.2): 12.
4. Media: Interlaced glass fibers sprayed with nonflammable adhesive.

5. Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, hinged, and with pull and retaining handles.

2.6 DAMPERS

- A. Damper Operators: Comply with requirements in Division 23 Section "Instrumentation and Control for HVAC."
- B. Outdoor- and Return-Air Dampers: Opposed-blade. Low-leakage, double-skin, airfoil-blade, galvanized-steel dampers with compressible jamb seals and extruded-vinyl blade edge seals in parallel -blade arrangement with steel operating rods rotating in stainless-steel sleeve bearings mounted in a single galvanized-steel frame, and with operating rods connected with a common linkage. Leakage rate shall not exceed 5 cfm/sq. ft. (0.22 L/s per sq. m) at 1-inch wg (250 Pa) and 9 cfm/sq. ft. (0.4 L/s per sq. m) at 4-inch wg (1.0 MPa).
- C. Mixing Section: Multiple-blade, air-mixer assembly located immediately downstream of mixing section.
- D. Combination Filter and Mixing Section:
 1. Cabinet support members shall hold 2-inch- (50-mm-) thick, pleated, flat, permanent or throwaway filters.
 2. Multiple-blade, air-mixer assembly shall mix air to prevent stratification, located immediately downstream of mixing box.

2.7 SOURCE QUALITY CONTROL

- A. Fan Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.
- B. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."
- C. Water Coils: Factory tested to 300 psig (2070 kPa) according to ARI 410 and ASHRAE 33.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine casing insulation materials and filter media before air-handling unit installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.

- C. Examine roughing-in for steam, hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Equipment Mounting – Indoor Applications: Install air-handling units on concrete bases. Secure units to anchor bolts installed in concrete bases.
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
 - 2. Install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- B. Arrange installation of units to provide access space around air-handling units for service and maintenance.
- C. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters.
- D. Install filter-gage, static-pressure taps upstream and downstream of filters. Mount filter gages on outside of filter housing or filter plenum in accessible position. Provide filter gages on filter banks, installed with separate static-pressure taps upstream and downstream of filters.

3.3 CONNECTIONS

- A. Comply with requirements for piping specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to air-handling unit to allow service and maintenance.
- C. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.
- D. Hot- and Chilled-Water Piping: Comply with applicable requirements in Division 23 Section "Hydronic Piping." Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.
- E. Connect duct to air-handling units with flexible connections.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Leak Test: After installation, fill water and steam coils with water, and test coils and connections for leaks.
2. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Air-handling unit or components will be considered defective if unit or components do not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify that shipping, blocking, and bracing are removed.
3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
5. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
6. Verify that outdoor- and return-air mixing dampers open and close, and maintain minimum outdoor-air setting.
7. Comb coil fins for parallel orientation.
8. Verify that proper thermal-overload protection is installed for electric coils.
9. Install new, clean filters.
10. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.

B. Starting procedures for air-handling units include the following:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm.
2. Measure and record motor electrical values for voltage and amperage.

3. Manually operate dampers from fully closed to fully open position and record fan performance.

3.6 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

3.7 CLEANING

- A. After startup service, clean air-handling units internally on completion of installation, according to manufacturer's written instructions. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils entering air face.
- B. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems, clean filter housings and install new, clean filters.

3.8 DEMONSTRATION

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

END OF SECTION 237313

SECTION 260500 – COMMON WORK RESULTS FOR ELECTRICAL

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 the work of this section.

1.2 DESCRIPTION

- A. The work of this section includes the furnishing and installation of all electrical equipment, materials and devices as shown on the electrical drawings and/or as specified herein, including but not limited to:
 - 1. Conduit and Wire
 - 2. Safety Switches and Fuses
 - 3. Panelboards
 - 4. Lighting and Lighting Control
 - 5. Fire Alarm Systems and Devices
 - 6. Telecom and Security Infrastructure Systems
- B. The term "provide" shall mean furnish and install.
- C. Applicable Publications:
 - 1. Where publications are listed in each Section, they form a part of that Section to the extent referenced.
 - 2. When a standard is specified by reference, comply with the requirements and recommendations stated in that standard, except when its requirements are modified by the Contract Documents, or applicable codes establish stricter standards.
 - 3. When a code is not specified by reference in a Section, the work of that Section shall comply with applicable codes listed in the General Conditions.
 - 4. The publication date is the publication in effect as of the bid date, except when a specific publication date is specified.
 - 5. Obtain copies of referenced standards direct from publication source, when needed for proper performance of work, or when required for submittal by Contract Documents.

1.3 QUALITY ASSURANCE

- A. Codes and Standards:
 - 1. The installation of all work under this section shall comply with all applicable codes, laws, standards and regulations. Nothing in the specifications shall be construed to permit deviation from these governing items.
 - 2. **Electrical material and equipment shall bear the UL label except where UL does not label such types of material and equipment. Materials, equipment and installation**

shall meet requirements of applicable codes and standards listed at the end of this specification.

B. Qualifications of Workmen:

1. Provide sufficient qualified journeyman electricians who are thoroughly experienced with the materials and methods specified and familiar with the design requirement.
2. At least one qualified journeyman shall be present at all times during the execution of the work.
3. In acceptance or rejection in any portion of the electrical work, no allowance will be made for lack of skill on the part of the workmen.

C. Definitions:

1. The term "as indicated" means as shown on drawings by notes, graphics or schedules, or written into other portions of contract documents. Terms such as "shown", "noted", "scheduled" and "specified" have the same meaning as "indicated", and are used to assist the reader in locating particular information.
2. The term "provide", means furnish and install.
3. The term "furnish", means supply to the project only, for installation under other Divisions as part of this contract.
4. The term "install", means to place and put in service equipment furnished under other Divisions as part of this contract.
5. The term "Owner's Representative" when referenced here in shall be the Architect unless otherwise noted.
6. The term "Division 21 Contractor" shall mean the fire protection subcontractor and their lower tier subs.
7. The term "Division 22 Contractor" shall mean the plumbing subcontractor and their lower tier subs.
8. The term "Division 23 Contractor" shall mean the HVAC subcontractor and their lower tier subs.
9. The term "Division 26, Division 27 or Division 28 Contractor" shall mean the electrical subcontractor and their lower tier subs.
10. For additional definitions refer to the General Conditions.

1.4 INTENT OF DRAWINGS AND SPECIFICATIONS

- A. The implied and stated intent of the drawings and specifications is to establish minimum acceptable quality standards for materials, equipment and workmanship, and to provide operable electrical and mechanical systems in every respect.
- B. The drawings are diagrammatic only, intending to show general arrangement and location of system components. Due to the small scale of the drawings, and to unforeseen job conditions, all required offsets and fittings may not be shown, but shall be provided at no change in contract price.

1.5 SUBMITTALS

- A. Submit shop drawings of the electrical materials to the Designer for review in accordance with the provisions of Division 01 of these specifications.

- B. The following is a list of those items required to be submitted:
 - 1. Conduit and Wire
 - 2. Safety Switches and Fuses
 - 3. Panelboards
 - 4. Wiring Devices
 - 5. Lighting and Lighting Control
 - 6. Fire Alarm System and Devices
 - 7. Telecommunications Systems
- C. Contractor shall not begin fabrication or work which requires submittals until return of submittals with Designer's approval.

1.6 SUBSTITUTIONS

- A. Within 30 days after contract date, submit to Designer a complete list of major products proposed to be used, with the name of the manufacturer and the installing subcontractor.
- B. Contractor's Options:
 - 1. For products specified only by reference standard, select any product meeting that standard.
 - 2. For products specified by naming several products or manufacturers, select any one of the products or manufacturers named, which complies with the specifications.
 - 3. For products specified by naming one or more products or manufacturers and "or equal", contractor must submit a request as for substitutions for any product or manufacturer not specifically named.
- C. Substitutions:
 - 1. For a period of 30 days after contract date, the Designer will consider written requests from the Contractor for substitution of products.
 - 2. Submit a separate request for each product, supported with complete data, with drawings and samples as appropriate, including:
 - a. Comparison of the qualities of the proposed substitution with that specified.
 - b. Changes required in other elements of the work because of the substitution.
 - c. Effect on the construction schedule.
 - d. Cost data comparing the proposed substitution with the product specified.
 - e. Availability of maintenance service, and source of replacement materials.
 - 3. The Designer shall be the judge of the acceptability of the proposed substitution.
- D. Contractor's Representation:
 - 1. A request for a substitution constitutes a representation that Contractor:
 - a. Has investigated the proposed product and determined that it is equal to or superior in all respects to that specified.
 - b. Will provide the same warranties or bonds for the substitution as for the product specified.

- c. Will coordinate the installation of an accepted substitution into the work, and to make the work complete in all respects.
 - d. Waives all claims for additional costs, under his responsibility, which may subsequently become apparent.
 - e. Absorb all costs incurred by the substitution when affecting other trades, including but not limited to electrical, structural and architectural, etc.
 - f. Absorb any cost incurred by the Owner's Representative in review of the substituted product if the acceptance of the substituted item creates the need for system modification and/or redesign, or if the substituting contractor exhibits negligence in his substituting procedure thus submitting inferior, misapplied or mis-sized equipment. In the event of additional Designer costs, the billing structure shall be agreed upon prior to review by all involved parties.
- E. The Designer will review the requests for substitutions with reasonable promptness, and notify Contractor, in writing, of the decision to accept or reject the requested substitution.

1.7 VISIT TO THE SITE

- A. All persons proposing to submit quotations for work in accordance with these plans and specifications MUST visit the site of the work covered by the plans and specifications; and are to familiarize themselves with existing conditions as they affect the work of this section of the specifications. Claims resulting from a failure to visit the site or inspect the existing conditions will not be considered.

1.8 OPERATING AND MAINTENANCE DATA

- A. Compile product data and related information appropriate for Owner's maintenance and operation of products furnished under Contract.
 - 1. Prepare operating and maintenance data as specified in this section and as referenced in the General Conditions and applicable Section of Division 1 General Requirements.
 - 2. Provide copies of all testing report data in the manual for future reference by the Owner.
- B. Instruct Owner's personnel in maintenance of products and in operation of equipment and systems.
- C. Preparation of data shall be done by personnel:
 - 1. Trained and experienced in maintenance and operation of desired products.
 - 2. Familiar with requirements of this Section.
 - 3. Skilled as technical writer to the extent required to communicate essential data.
 - 4. Skilled as draftsman competent to prepare required drawings.
- D. Prepare data in form of an instructional manual for use by Owner's personnel.

1.9 PAINTING

- A. Suitable finish coatings shall be provided under this section of the Specifications on all items of electrical equipment and wiring which are exposed. This shall consist of either an approved

factory applied finish or an acceptable finish applied during or after installation. Equipment which is furnished in finishes such as stainless steel or satin aluminum are not to be painted. Exposed equipment and/or wiring in finished areas such as panel covers or surface raceway shall be supplied with factory applied prime coat and shall be professionally painted or enameled as directed to result in a completely coated and attractively finished manner. All such finishing shall be as directed and shall be satisfactory to the Designer.

- B. All factory-finished steel surfaces; boxes, enclosures, etc., shall be cleaned and retouched or repainted as necessary to provide a rust-resistant coating. Where painting or galvanizing is not specifically specified, ferrous devices, bolts, nuts, inserts, etc., shall be galvanized.
- C. All nameplates shall be left unpainted and in a clean condition.

1.10 WIRING AND ELEMENTARY DIAGRAMS

- A. Wiring and elementary diagrams for equipment as shown on the drawings are based on the product of the specified equipment manufacturer and are shown for convenience to aid in estimating the extent of the work involved. The equipment actually installed shall be wired and connected in accordance with the equipment manufacturer's recommendations and shall conform to details in approved wiring diagrams to be furnished by the equipment manufacturer. All equipment so connected shall be made to operate in a safe, proper and efficient manner. Note that control circuitry is not necessarily shown on the drawings but shall be installed in conduit between the points and devices indicated on the diagrams.

1.11 POWER AND CONTROL WIRING RESPONSIBILITIES FOR SYSTEMS OTHER THAN ELECTRICAL

- A. Definitions:
 - 1. Power Wiring (by electrical contractor): The contractor shall provide all wiring to the line side of junction boxes or disconnects for all mechanical and plumbing equipment. Wiring from the load side of the junction box or disconnect shall be provided by the Div. 22/23 contractor for plumbing and mechanical systems.
 - 2. Control Wiring (by Automatic Temperature Control Contractor; ATC): All wiring, high or low voltage other than power wiring, required for the proper control operation of the mechanical systems.
- B. Refer to specification Division 22/23 and coordinate all requirements with that division prior to commencing work. Bring to the attention of the Designer any items requiring clarification.

1.12 EQUIPMENT TESTS

- A. An operating test of the complete electrical system shall be made. System shall test free from grounds, shorts and other faults. Connections shall be for positive mechanical and electrical connection and continuity. Equipment shall be demonstrated to operate in accordance with the requirements of the plans and specifications. Contractor shall furnish all personnel and test instruments required. Performance of tests shall be made in the presence of the Owner's representative.
- B. The following tests shall be performed as a minimum:

1. Control and Distribution Equipment:
 - a. Check the wire terminals, clean connections.
 - b. Check all control switches, alarm devices, indicating instruments for proper operation under normal and simulated abnormal conditions.
 2. Phase rotation: The connections of all equipment shall be checked for correct phase rotation.
 3. Circuit Breakers: The following tests shall be performed:
 - a. Inspect each circuit breaker.
 - b. Check for loose connections.
 - c. Operate each circuit breaker manually.
 - d. Set the adjustable trips to the values specified.
- C. Spot-checks and/or back-checks to verify the testing accuracy shall be made for the Designer or his agent during job-site visits.
- D. Validity of the ground path shall be assured by constant and careful attention to the thorough tightening of all couplings, connectors, locknuts, screws, bolts, etc. and by frequent checking of the path resistance with a quality low-range ohmmeter. Resistance of the path should not exceed one ohm between any two points. If a reading in excess of this is observed, it shall be discussed with the Designer for an appraisal of the condition.
- E. All current carrying phase conductors and neutrals shall be tested as installed, and before connections are made, for insulation resistance and accidental grounds. This shall be done with a 500 volt cable insulation testing device. The procedures listed below shall be followed:
1. Minimum readings shall be one million (1,000,000) or more ohms for #6 AWG wire and smaller, 250,000 ohms or more for #4 AWG wire or larger, between conductors and between conductor and the grounding conductor.
 2. After all fixtures, devices and equipment are installed and all connections completed to each panel – disconnect neutral feeder conductor from neutral bar and take a resistance reading between neutral bar and grounded can. If this reading is less than 250,000 ohms, disconnect branch circuit (or sub-feeder) neutral wires from this neutral bar. Test each one separately to the panel can until low reading ones are found. Correct troubles, reconnect and retest until at least 250,000 ohms from neutral bar to grounded panel can is achieved with only neutral feeder disconnected.
- F. Upon completion of work, but before final inspection, the Contractor shall send a letter to the Designer and the Owner certifying that these tests have been accomplished and tabulating the resistance readings for each panel. During field visits, contractor shall demonstrate installation and make such tests as may be required to satisfy the Architect/Designer and Owner that work is installed in accordance with drawings, specifications and instructions.
- 1.13 WARRANTY
- A. All equipment installed under this Division of the work shall be warranted for a minimum of one year after the specified performance has been demonstrated and accepted by the Owner.

During this warranty period, replace any and all defective equipment and parts at no cost to the Owner.

1.14 BRANCH CIRCUITS

- A. The branch circuit wiring has been designed to utilize the advantages of multi-wire distribution and shall be installed substantially as indicated on the drawings. No major changes in the grouping or general routing of the branch circuits shall be made without the approval of the Designer in writing.
- B. The number of conductors in each run of conduit is indicated on the drawings and where there is a conflict between the number of wires indicated and the actual number required as determined by the functional design requirements, the number of wires determined by the functional design requirements shall govern.
- C. In general, there is a number associated with each branch circuit outlet which identifies the particular branch circuit to which the device served by the outlet is to be connected. The circuit number indicated has been assigned only for reference and guidance, and is not intended to limit panelboard circuitry. All branch circuits shall be connected to breakers in accordance with circuit requirements and good industry practice. The balancing of all loads shall be included in the work of this DIVISION.
- D. Home runs shall not be combined where such would require derating of conductor ampacity.
- E. **Branch circuit wiring shall include SEPARATE neutrals for each circuit. No combining of neutrals will be allowed.**

1.15 MOTOR, APPLIANCE AND EQUIPMENT CONNECTIONS

- A. Unless otherwise shown on the drawings or specified herein, it is the intent of this DIVISION to provide all electrical equipment and connections required to protect, properly operate, and control all motors, appliances, electrical devices, and equipment furnished and installed under this and other DIVISIONS of the specifications or shown on the drawings.

1.16 SETTING OF EQUIPMENT

- A. The setting of equipment shall be carefully coordinated with the work and requirements of the other trades involved to ensure compatibility and to avoid conflicts.
- B. Equipment, base mounted on concrete or masonry slabs, pads and piers, or mounted on stands, gratings, platforms, or other, shall not be set in any manner, except on the finished and permanent support.
- C. Support of equipment on studs or by other means, and the placing or building of the supporting slab, pad, pier, stand, grading, or other, "to the equipment", is prohibited.

1.17 PLYWOOD BACKBOARDS

- A. For mounting electrical or telephone equipment, provide fire-retardant treated plywood panels with grade designation, APA C-D PLUGGED INT with exterior glue, in thickness indicated, or, if not otherwise indicated, not less than 15/32".

1.18 RECORD DRAWINGS/MANUALS

- A. Upon completion of the installation, Contractor shall submit to the Architect/Designer marked prints of drawings showing any changes made in circuits, location of equipment, panelboards or any other revision in the Contract Drawings, for the Owner's use in maintenance work and for future additions and expansions. Marked changes shall also include changes due to change orders unless already recorded by revised drawing or bulletin drawing.
- B. These records shall be submitted in one of two formats: either a clean, legible, marked set of prints with all markings in distinguishable colored pencil such as red; or a set of reverse-run reproducible sepia prints marked in soft pencil so that blue-line prints can be reproduced as required. The format to be used shall be as defined in the General Requirements section of the contract documents. If no format is defined, the marked blue-line prints shall be submitted.
- C. Operation and Maintenance manuals shall be submitted to the Architect/Designer at the end of the project prior to closeout of the project. Information included shall be a copy of all submittal data, shop drawings and necessary operating and maintenance instructions and wiring diagrams on all major items of equipment and all special systems (fire alarm, intercom, etc.). Submit these manuals in the quantities and format described in the General Requirements section.
- D. **Provide a laminated copy of the electrical one-line no smaller than 11x17 complete with wire sizes and panel names. This shall be permanently affixed at the building's MDP and in each space where an electrical panel is located. The Designer shall provide a paper copy for the Contractor's use.**

1.19 All products specified herein and indicated on the drawings shall be Y2K compliant.

1.20 It shall be the sole responsibility of the Division 26 contractor to notify the Office of the State Consulting Services Section of any necessary inspections and to schedule said inspections. Inspections will only be made Monday-Friday unless specifically exempted and approved by the State Construction Office.

APPENDIX

**THIRD PARTY AGENCIES ACCREDITED BY THE NCBCC TO
LABEL ELECTRICAL & MECHANICAL EQUIPMENT AS OF MARCH 1, 2018**

Applied Research Laboratories

5371 Northwest 161st Street, Miami, Florida 33014
(305) 624-4800

Equipment Categories

12, 14, 15, 22, 24, 31, & 43

CSA International

178 Rexdale Boulevard, Toronto, Ontario, Canada M9W 1R3
(416) 747-2798

Equipment Categories

All

Curtis-Straus

527 Great Road, Littleton, Massachusetts 01460
(978) 486-8880 x 296

Equipment Categories

7, & 26-28

FM Approvals LLC

PO Box 9102, Norwood, Massachusetts 02062
(781) 762-4300

Equipment Categories

4, 5, 9, 13, 17, 19, 24, 28, 31, 32, 39, 43,
& 47-51

IAPMO EGS

5001 East Philadelphia Drive, Ontario, California 91761
(909) 472-4100

Equipment Categories

12, & 30

Intertek Testing Services ITS-ETL

3933 US Route 11, Cortland, New York 13045-2014
(607) 753-6711

Equipment Categories

All except 21

Intertek Testing Services ITS-Warnock

3933 US Route 11, Cortland, New York 13045-2014
(607) 753-6711

Equipment Categories

17, 18, 21, 24, & 25

LabTest Certification, Inc.

#112-3255 Pepper Lane, Las Vegas, Nevada 89120
(702) 269-0578

Equipment Categories

17 & 18

MET Laboratories

901 Sheldon Drive, Cary NC 27513
(919) 481-9319

Equipment Categories

7, 10-16, 18, 22, 23, 26-31, 37-40, 43,
44, 78, 48 & 50

National Technical Systems (NTS)

533 Main Street, Acton, MA 01720
(978) 263-2933

Equipment Categories

26, 27, & 28

NEMKO North America, Inc.

2210 Faraday Avenue, Suite 150, Carlsbad, California 92008
(760) 444-3500

Equipment Categories

6-16, 22, 23, 26-31, 40, 43, 47, & 48

NSF International

789 North Dixboro Road, Ann Arbor, Michigan 48105-9723
(734) 769-8010

Equipment Categories

11-16, 26-31, 40, 43, & 48

Omni-Test Laboratories

13327 NE Airport Way, Portland, Oregon 97230
(503) 643-3788

Equipment Categories

17, 18, & 21

PFS Corporation

1507 Matt Pass, Cottage Grove, Wisconsin 53527
(608) 839-1013

Equipment Categories

17, 21, & Replacement Blowers & coils

QPS Evaluation Services, Inc.

1501 Valley Creek Drive, Hillsborough, North Carolina 272787
(919) 414-5381

Equipment Categories

6-12, 14-16, 22, 23, 26-29, 31, 36, 39,
40, 43, 46-48, 50, & 51

RADCO

3220 East 59th Street, Long Beach, California 90805
(310) 272-7231

Equipment Categories

17, 18, Replacement blowers & coils

Salus Engineering International

3004 Scott Boulevard, Santa Clara, California 95054
(408) 235-8831

Equipment Categories

16, 28, 37, 43, & 50

SGS Consumer Testing Services

620 Old Peachtree Road, Suite 100, Suwanee, GA 30024
50-51
(770) 570-1800

Equipment Categories

1-5, 9-16, 22, 26-31, 33, 35-41, 43, 47-48, &

Southwest Research Institute

6220 Culebra Road, San Antonio, Texas 78238-5166
(210) 684-5111

Equipment Categories

4

TUV SUD America

10 Centennial Drive, Peabody, MA 01960

(978) 573-2530

Equipment Categories

4-8, 10-20, 22, 23, 26-29, 31, 35, 36,
38,
39, 43, 46-48, & 50

TUV Rheinland of North America

762 Park Avenue, Youngsville, North Carolina 27596
50
(919) 554-3668

Equipment Categories

7-9, 11-14, 16, 26-28, 31, 40, 43, 47-48, &

Underwriters Laboratories, Inc.

12 Laboratory Drive, RTP, North Carolina 27709
(919) 549-1400

Equipment Categories

All

EQUIPMENT CATEGORIES

1. Conductors for General Wiring
2. Flexible Cords
3. Wires and Cables for Special Applications
4. Materials and Components for Special Applications
5. Alarm Signal and Detecting System Components
6. CATV and Radio Distribution System Components
7. Communication System Components
8. Radio and Television Components
9. Energy Management System Components and Controllers
10. Sound Recording and Reproduction Equipment
11. Fixed Office Appliances and Business Equipment
12. Electrical Appliances
13. Electric Space Heating Equipment and Accessories
14. Air Conditioning Equipment and Accessories

15. Heat Pump Equipment and Accessories
16. Refrigeration Equipment and Accessories
17. Gas Fired Heating Equipment and Accessories
18. Gas Fired Appliances
19. Oil Fired Heating Equipment and Accessories
20. Oil Fired Appliances
21. Solid Fuel Heating Equipment
22. Fans and Ventilators
23. Filtering Equipment
24. Duct Materials Including Dampers
25. Chimneys and Vents
26. Electrical Data Processing Equipment
27. Medical, Dental, and X-Ray Equipment
28. Laboratory Equipment, Electrical Measuring, and Testing Equipment
29. Food Preparation Machines
30. Swimming Pool and Spa Equipment
31. Miscellaneous Fixed Equipment - Amusement Machines, Animal Care, Appliances, Battery Chargers, Cleaning Machines, etc.
32. Fire Extinguishing Equipment
33. Circuit Breakers
34. Fuses
35. Wiring Devices, Attachment Plugs and Toggle Switches
36. Switches and Switching Devices - Other than Toggle
37. Panelboards
38. Switchboards
39. Transformers
40. Electrical Signs and Accessories
41. Ground-Fault Circuit Interrupters
42. Ground-Fault Sensing and Relaying Equipment
43. Industrial Control Equipment - Motor Controllers, Industrial Control Panels, Motor Control Centers, Motorized Valves, Solenoids, etc.
44. Transient Voltage Surge Suppressors and Filters
45. Lightning Protection System Components and Lightning Protection Devices
46. Metering Enclosures and Meter Sockets
47. Emergency Lighting and Power Equipment System Components
48. Lighting Fixtures, Lamp Holders, and Accessories
49. Auxiliary Gutters, Junction, Pull and Outlet Boxes, and Cabinets and Cutout Boxes
50. Electrical Equipment for Hazardous Locations
51. Grounding and Bonding Equipment
52. Wire Connectors, Lugs, and Terminal Fittings
53. Insulating Tape and Closures

END OF SECTION 260500

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SECTION 260501 - GENERAL ELECTRICAL REQUIREMENTS FOR RENOVATION AND DEMOLITION

PART 1 - GENERAL

- 1.1 Related Documents: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division – 1 Specification sections, apply to the work of this section.
- 1.2 Provide all electrical demolition work necessary to install new work. Electrical contractor shall reroute and reconnect any circuits that will remain in use but interferes with new construction.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

- 3.1 Demolition items shall include, but are not limited to the following for the areas indicated on the drawings:
 - A. Conduit
 - B. Wire
 - C. Receptacles
 - D. Switches
 - E. Junction Boxes
 - F. Panelboards
 - G. Lighting Fixtures
 - H. Transformers
 - I. Safety Switches
- 3.2 All existing conduits that will not be reused shall be removed where they will be exposed or accessible (i.e. above lay-in ceilings) after completion of construction. All others may be abandoned in walls only. Contractor shall remove all wiring from abandoned conduits, disconnect from all power sources and provide blank plates on all abandoned outlets.

- 3.3 Maintain continuity of all existing circuits and communications wiring to remain or portions thereof affected by new work. Any disruption of electrical circuits or telecommunications wiring shall be repaired by the Contractor.
- 3.4 The Owner shall determine which materials removed under demolition will become property of the contractor and which materials will remain property of the Owner. The material which becomes property of the contractor shall be removed completely from the site.
- 3.5 Contractor shall exercise care in removing demolition items and shall repair or replace at their cost any damage caused to existing construction and equipment to remain.

Drawings are based upon existing plans and field investigations done prior to demolition. Contractor shall visit the existing building and familiarize themselves with existing conditions.

END OF SECTION 260501

SECTION 260519 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS

PART 1 - GENERAL

- 1.1 Related Documents: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division - 1 Specification sections, apply to the work of this section.
- 1.2 All conductors shall be copper of the number and AWG sizes shown on the drawings and sized to equal or exceed the requirements of the NEC. Insulation shall be rated for 600 volts. Where not shown otherwise, wiring shall be not less than No. 12 AWG
- 1.3 All conductors shall be in conformance with NEMA WC-3 (rubber-insulated wire and cable), WC-5 (thermoplastic-insulated wire and cable), and WC-7 (cross-linked-thermosetting-polyethylene-insulated wire and cable) for the transmission and distribution of electrical energy.
- 1.4 Each coil of wire shall be delivered to the job in its original unbroken wrapping bearing Underwriter's Laboratories listing.
- 1.5 All conductors shall be copper, Type THHN/THWN insulation stranded except conductors, #10 AWG or smaller, shall be solid.
- 1.6 Conductors No. 6 and smaller shall be identified by a continuous insulation color. Conductors larger than No. 6 shall be identified by three laps of colored tape equal to Scotch #35 at each point of access to the conductors. Color coding shall be as follows:

	208 Volt
Phase A Conductor	Black
Phase B Conductor	Red
Phase C Conductor	Blue
Grounded (Neutral) Conductor	White
Grounding Conductor	Green

- 1.7 Number code all control instrument wiring at all points of access, including junction boxes.
- 1.8 All wire sizes shown on the drawings are based upon the use of copper conductors with 75 degrees C rated insulation. Where appliance or equipment terminals are rated for 60 degrees C connections, conductor sizes and ampacities shall be based on 60 degrees C insulation. Where appliance or equipment terminals are rated for 60/75 degrees C connections, conductor sizes and ampacities shall be based on 60 or 75 degrees C insulation. Where appliance or equipment terminals are rated for 75 degrees C connections, conductor sizes and ampacities shall be based on 75 degrees C insulation.

PART 2 - PRODUCTS

- 2.1 Conductors shall be manufactured by American, Rome, Triangle, Southwire, Okonite or approved equal.
- 2.2 Conductors inside buildings shall have moisture and heat resistant thermoplastic insulation, type "THHN/THWN", or "XHHW", rated for 600 volts unless other types are required by the Code.
- Type "THHN" shall not be used in wet or damp locations and, where used, shall have an ampacity rating based on the temperature rating of the termination lugs, equipment, devices, etc.
- 2.3 Unless otherwise indicated, conduit sizes shown on the drawings are based upon the use of type THWN insulated conductors. Conduit sizes shall be increased where required by the NEC for the type insulation used.
- 2.4 Control wiring may be No. 14 AWG except where length of runs would not permit proper operation of the controls or where larger sizes are required by code.
- A. Class 1 remote control and signal circuit conductors shall not be smaller than No. 14 AWG.
- B. Class 2 low energy remote control and signal circuit conductors shall not be smaller than No. 16 AWG, unless noted otherwise on the drawings or recommended by the equipment manufacturer incorporating such wiring.
- C. Conductor insulations shall be as specified herein before except that No. 16 AWG conductors for remote control or signal circuits may be commercial grade fixture wire, Type RF-2, TF or other types recognized by the NEC as applicable for the purpose.
- 2.5 The use of type NM, NMC and MC cable is prohibited.
- 2.6 Instrumentation cables shall be low signal level type, 16 AWG, stranded copper with insulation of chemically cross-linked polyethylene or flame retardant ethylene propylene, 90 degrees C, 600 volts. Conductors shall be arranged as twisted pair, 1-1/2 inch minimum lay. Shielding shall be 100 percent coverage aluminum polyester tape with 18 gage bare, tinned, copper drain wire in continuous contact with tape. Jacket shall be polyvinyl chloride or chlorinated polyethylene, suitable for installation in cable tray.
- 2.7 Connections to motor "pig-tails" shall be by copper split-bolt type connectors "wrapped" with one layer of varnish tape, then one layer of rubber tape then one layer of electrical tape.
- 2.8 Terminal strips shall be Barrier type, rated 600 volts.

PART 3 - EXECUTION

- 3.1 Provide all wire and cable of AWG sizes indicated on the drawings and as specified or required to provide a complete installation.

- 3.2 Unless otherwise noted, splices in No. 8 and smaller conductors shall be made with screw type connectors listed by UL as 600 volt pressure cable connectors for branch circuit and fixture splicing applications and shall be equal to IDEAL "WING NUTS", SCOTCHLOK Spring Connectors, 3M wire nuts or approved equal connectors. Splices in copper conductors larger than No. 8 shall be made with Thomas and Betts, 3M, Burndy, or approved equal solderless connectors with molded composition covers.
- 3.3 Wiring must be installed in conduit and the minimum size conduit is ¾". Install splice-free conductors within ducts, conduits or earth.
- 3.4 Conductors shall be continuous from outlet to outlet with splices made only in outlet or junction boxes.
- 3.5 Insulate splicing connectors to at least 200 percent of insulation. Use pre-stretched tubing connector insulators, 3/M PST, for No. 2 and larger conductors. Pull conductors using recognized methods and equipment leaving eight inches (minimum) of wire at junctions for connections.
- 3.6 Use UL listed compound as required to facilitate pulling. Complete connections and clean out conduit system before pulling wire.
- 3.7 Form and tie all wiring in panelboards utilizing Velcro style wire ties that will allow ease of access to conductors by the Owner's maintenance staff.
- 3.8 Wiring in hot locations and for recessed fixtures shall have heat-resistant insulations applicable for the purpose.
- 3.9 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. 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.

END OF SECTION 260519

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SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEM

PART 1 - GENERAL

- 1.1 Related Documents: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division - 1 Specification sections, apply to the work of this section.
- 1.2 Grounding shall be installed in accordance with the National Electrical Code and shall include ground and equipment grounds for all electrically operated equipment.
- 1.3 Grounding conductors shall be run with all lighting and power circuits 120V and above, and be bonded to all equipment or devices. Grounding conductors shall be run in all flexible metal conduits, including liquidtight conduit. Grounding conductors shall be installed elsewhere as shown.
- 1.4 The grounding system shall be bonded together and effectively ground all exposed, non-energized metal surfaces containing energized parts, devices or conductors, all metallic electrical raceways and the neutrals and cases of all transformers.
- 1.5 Resistance from the main ground electrode to ground shall not exceed 25 ohms. When measured values exceed this amount, install a sufficient number of grounding electrodes to lower the resistance to a value within the specified limit.

PART 2 - PRODUCTS

- 2.1 Service grounding conductor and building grounding conductors shall be bare stranded copper sized as shown on the Drawings.
- 2.2 Equipment grounding conductors in raceways shall be insulated copper sized as shown on the Drawings.
- 2.3 Direct buried ground connections shall be exothermic type Cadweld or Thermoweld.

PART 3 - EXECUTION

3.1 BUILDING SYSTEMS GROUNDING

- A. The main service ground clamp shall be attached to the cold water main at an accessible point and before its size is reduced immediately after it enters the building. Clamp shall be accessible after construction is complete. Grounding conductor shall be without splice into the service enclosure where it shall be connected to main service neutral. Grounding type insulated bonding bushings and jumpers shall be provided where conduits terminate in service entrance equipment, transformers, and where concentric, eccentric or over-sized knockouts are encountered. The jumpers shall be sized per NEC Table 250-66 for services, and transformers, and per Table 250-122 for branch circuits.

- B. In addition to the clamp on the water main, a supplemental electrode shall be provided. This supplemental electrode shall consist of one of the following:
 - 1. Three 10 foot minimum copper clad ground rods, 3/4" in diameter, driven to a depth so top of rod is below finished grade. Grounding conductor shall be continuous and sized as shown on plans. The grounding conductor conduit shall be fastened to service enclosure with double locknuts and bonding bushing.
- C. In addition, the metal frame of the building shall be bonded to the grounding electrode system using a conductor sized the same as the main grounding conductor on the drawings.
- D. Bonding shall be done with approved insulated bonding bushings and compression type lugs.
- E. Grounding conductor shall be Type TW or THHN/THWN run in heavy wall conduit, and of size shown on drawings or required by NEC.
- F. A grounding conductor shall be installed and solidly connected to all electrical equipment such as dry type transformer neutrals, motor control center ground buses, housings, switchgear, panelboards, switchboard, wireways, motor frames, controllers, generators, transfer switches, conduits, etc., in accordance with code requirements and as shown on the drawings. Connections to the equipment may be bolted or screwed using corrosion resisting bolts, nuts and screws as required for a solid and permanent connection.
- G. Bonding jumpers shall be installed. Bare grounding conductors, where passing through steel sleeves, shall be bonded to the steel at entrance and exit.
- H. **Upon completion of installation of the grounding electrode and bonding system at the service entrance location, the ground resistance shall be tested per IEEE Fall-of Potential testing procedures. Resistance to ground shall be less than 25 ohms. Should the test show more than 25 ohms of resistance, the contractor shall provide additional ground rods as necessary and re-test the system. All systems tests shall be documented including any tests that fail. Test shall be performed prior to energization of the service.**

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

- 1.1 Related Documents: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division - 1 Specification sections, apply to the work of this section.
- 1.2 All conduits shall be properly supported in accordance with these specifications and the latest NEC.

PART 2 - PRODUCTS

2.1 CONDUIT SUPPORTS

- A. Single Runs: Galvanized conduit straps on ring bolt type hangers with specialty spring clips. Do not use plumbers perforated straps.
- B. Multiple Runs: Conduit racks with 25 percent spare capacity.
- C. Vertical Runs: Channel support with conduit fittings.

2.2 ANCHOR METHODS

- A. Hollow Masonry: Toggle bolts or spider type expansion anchors.
- B. Solid Masonry: Lead expansion anchors or preset inserts.
- C. Metal Surfaces: Machine screws, bolts, or welded studs.
- D. Concrete Surfaces: Self-drilling anchors

2.3 Indoors in Dry Areas: Materials shall be galvanized or cadmium plated steel.

2.4 Indoors in Wet, Damp or Corrosive Areas: Threaded materials shall be stainless steel. All other materials shall be aluminum and/or stainless steel.

2.5 Outdoors: Threaded materials shall be galvanized steel. All other materials shall be aluminum, stainless steel, or both.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Layout to maintain headroom, neat mechanical appearance, and to support equipment loads required.
- B. Conduits installed on the interior of exterior building walls shall be spaced off the wall surface a minimum of 1/4 inch using "clamp-backs" or strut.
- C. Loading of Equipment Supports:
 - Spans up to 5 feet: Deflection shall not exceed 1/240 of span.
 - Spans 5 feet and greater: Deflection shall not exceed 1/360 of span.
 - Compressive loading shall not exceed 33 percent of manufacturer's published ratings.

END OF SECTION 260529

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

- 1.1 Related Documents: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division - 1 Specification sections, apply to the work of this section.
- 1.2 Unless otherwise shown or specified, raceways shall be provided for all conductors, including but not limited to lighting, power, control, fire alarm, communications and telephone. All conduit shall be UL listed and so labeled.
- 1.3 Raceways shall be installed as a complete system without wires and shall be continuous from outlet to outlet and from fitting to fitting. Raceways shall be mechanically and electrically connected to all boxes and fittings and shall be properly grounded.
- 1.4 The routing and location of all conduits and other raceways shall be coordinated with other trades and with the building construction to avoid conflicts.
- 1.5 Where conduit and other raceway sizes are not specifically shown on the plans, conduits shall be sized in accordance with the requirements of the NEC. No conduit shall be less than 3/4" above grade and 1 1/4 " below grade.

PART 2 - PRODUCTS

- 2.1 Rigid Metal Conduit (RGS) shall be manufactured by Allied, Triangle, Wheatland or approved equal, in accordance with UL 6 and ANSI C80.1. Conduit shall be low carbon, hot-dipped galvanized inside and out, with threaded ends, 3/4" inch minimum size. Fittings shall be cast iron or alloy steel, threaded and galvanized.
- 2.2 Electrical metallic tubing (EMT) shall be as manufactured by Allied, Triangle, Republic, or approved equal, in accordance with UL 797 and ANSI C80.3. EMT shall be high-strength, zinc-coated, 3/4 inch minimum size. EMT shall not be utilized for service entrance conductors. Fittings shall be of same finish and material as tubing. Fittings shall be steel, hexagonal compression type, with insulated throat. Pot-metal, set-screw or indented fittings shall not be utilized.
- 2.3 Flexible metal conduit shall be in accordance with UL 1 and ANSI C33.92. Conduit shall be galvanized. Flexible metal conduit shall be secured to boxes and enclosures with angle saddle type connector with bushings between the conductors and the conduit. Minimum size 3/4" except 1/2 " may be used for lighting whips in lengths less than 6'-0".
- 2.4 Rigid Non-Metallic conduit shall be NEMA TC-2, Type EPC-40-PVC with NEMA TC-3 fittings.
- 2.5 Liquidtight flexible metal conduit shall be provided in accordance with UL 360. Conduit shall have galvanized steel core and moisture and oil resistant thermoplastic cover. Minimum size 3/4".
- 2.6 Expansion Joint Fittings: Watertight, permitting two-way movement up to 4 inches, equipped with bonding jumpers around or through each fitting.

- 2.7 Sealing Material for Sealing Fittings: Chico X Fiberdam, and Chico A sealing compound, or Chico A-P interpak by Crouse-Hinds or Apelco sealing cement and fiber filler by Appleton or equal by 3M Corp.
- 2.8 Insulated Bushings: Type B or SBT, as applicable, by O-Z Gedney or series B1900, series BU500 or series TC700, as applicable, by Steel City or equal by T&B.
- 2.9 Pulling in Wire: Provide a 100# nylon pull rope in each row of empty conduit.
- 2.10 Wireways and wiring troughs shall be code gauge galvanized steel, sized as shown, or as required by the NEC. Covers shall be screwed. Where indicated as raintight, wireways shall be galvanized and shall comply with the NEMA requirements.
- 2.11 BOXES, ENCLOSURES, AND CABINETS
 - A. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
 - B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
 - C. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
 - D. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized, cast iron with gasketed cover.
 - E. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - F. Cabinets:
 - 1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

- 3.1 Rigid steel conduit shall be installed with threaded fittings and couplings. Where conduits terminate in a threadless opening, locknuts shall be provided both inside and outside of the box or enclosure and the conduit end shall be fitted with an insulating bushing. Where bonding is required, the end of the conduit shall be equipped with an insulated metallic grounding and bonding bushing.

- 3.2 Liquidtight flexible metal conduit shall be secured with approved liquidtight fittings with insulated throats.
- 3.3 All metallic couplings, connectors and fittings shall be malleable iron or steel and finished with zinc plating or by galvanizing.
- 3.4 All conduits shall be plugged after installation to prevent the entrance of construction dirt and debris. Conduits shall be clean before wires are pulled.
- 3.5 In wet or damp locations, all fittings shall be installed with suitable watertight gaskets.
- 3.6 Where raceways pass through walls, partitions and floors, seal penetrations to provide a neat installation which will maintain the integrity of the waterproofing or fireproofing, as applicable, of the structure. Coordinate installation requirements with roofing installer where conduits pass through the roof.
- 3.7 Conduit provided outdoors above grade shall be rigid steel conduit.
- 3.8 Conduit run underground, **OUTSIDE THE BUILDING**, shall be rigid non-metallic conduit encased in concrete. "Turn-ups" from below to above grade shall be provided by installation of rigid metallic elbows and a transition to rigid steel conduit.
- 3.9 Conduit located indoors, not in mechanical, electrical or elevator machine rooms or **UNDERSLAB**, may be EMT. All other indoor conduits shall be rigid steel.
- 3.10 Flexible metal conduit may be used indoors for connections to lighting fixtures in accordance with the NEC. Liquidtight metal conduit of sufficient length to eliminate vibration shall be used for connections to motors, transformers, and other equipment requiring flexibility.
- 3.11 The use of flexible metal conduit shall be limited in application to the connection of lighting fixtures and miscellaneous equipment, and in lengths not to exceed six feet. Fittings shall be of a type approved for grounding purposes.
- 3.12 Expansion fittings shall be utilized in all cases where conduits pass through or across building expansion joints. Fittings shall be of an approved weatherproof telescopic type permitting a movement of up to four inches and shall be provided with approved bonding jumpers around or through the fitting. Contractor shall review the structural drawings for locations of expansion joints.
- 3.13 All conduits shall be properly supported using galvanized malleable iron conduit clamps for individual runs. Multiple runs shall be supported on channel adequately secured to walls or hung from structure above with conduits fastened to channel with clamps designed for the purpose.
- 3.14 Raceways shall be run at least 6" from hot flues, steam pipes, hot water pipes and other hot surfaces.
- 3.15 All raceways entering a building from underground shall be sealed to prevent water, moisture, gas, or any other foreign matter from entering the building. Conduits shall be sealed in accordance with NFPA 70 Sections 225.27 and 230.8.

- 3.16 No flexible conduits or Condulets shall be used for the telecommunications raceway system. In addition, there shall be no more than a total of 180 degrees of bends in any telecommunications raceway system without the installation of an accessible pullbox.
- 3.17 Connection of Conduit to Sheet Metal Boxes and Enclosures:
- A. Connection to NEMA 1 type boxes and enclosures:
 - 1. Rigid Metal Conduit: Install insulated bushings and double locknuts.
 - 2. EMT: Install compression steel box connectors with insulated throats.
 - B. Connection to NEMA 3R, 4, 4X, and 12 type boxes: Install insulated bushings and sealing locknuts or hubs.
 - C. When conduits enter floor mounted enclosures from below and there is no sheet metal to which to attach; install grounding bushings on the conduit. Bond bushings to ground bus using a conductor the same size as required for an equipment grounding conductor sized for the given circuit.
 - D. Install sealing bushing within all conduits which have entered a building from outside, whether from above or below grade.
- 3.18 BOX INSTALLATION
- A. Pull and junction boxes, where concealed in unplastered masonry, shall be square corner masonry type.
 - B. Boxes for exposed work shall be FS or FD series "Condulets" of a type and size applicable for the intended use at the locations shown on the drawings. SE and SEH Series "Condulets" shall be used for ceiling boxes where round boxes are required. Steel boxes will not be permitted for this purpose. Covers for use with these boxes shall have cadmium plated finish and shall be of rounded-edge design with openings to suit devices. Where the general arrangement and number of conduits prohibit the use of a single box, additional boxes shall be used as junction boxes and they shall be of the same general design as the outlet boxes. Provide weatherproof covers in outdoor areas. Such boxes shall be Crouse-Hinds or equivalent Appleton or Pyle-National.
 - C. Boxes installed in concrete construction shall be galvanized concrete type at all locations, except that cast iron boxes shall be installed for watertight fixtures or devices.
 - D. Boxes installed in unplastered masonry shall have covers of sufficient depth to avoid undue cutting of the masonry units.
 - E. Special care shall be exercised in the location of pull and junction boxes in order that access not be obstructed by piping or ductwork installed by other trades. To this end, the work shall be coordinated with representatives of the other trades. Boxes shall be independently and securely supported.

- F. Pull boxes shall be installed at all necessary points, whether indicated on the drawing or not, to prevent injury to the insulation or other damage that might result from pulling resistance or for other reasons necessary to proper installation.
- G. Where boxes are used in exposed conduit runs, plain covers shall be attached to the box with a suitable number of countersunk flathead machine screws or slotted truss head bolts. Flush covers of similar construction shall be used for flush mounted boxes.
- H. ALL Junction and pull boxes for branch circuits, fire alarm or communication systems shall be identified by spray painting the interior and exterior of the box and the cover. In addition, the box cover shall be labeled using a permanent, black marking pen to identify circuits or systems in box. Color code for spray painting of boxes shall be per Section 260553 of the Specifications.
- I. Clean boxes of all foreign matter prior to installation of wiring or devices.

END OF SECTION 260533

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SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

- 1.1 Related Documents: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division – 1 Specification sections, apply to the work of this section.
- 1.2 Furnish and install engraved laminated phenolic nameplates for all safety switches, panelboards, transformers, switchboards, motor control centers and other electrical equipment supplied for the project for identification of equipment controlled or served, phase, voltage, etc.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Nameplate material colors shall be:
 - 1. Blue surface with white core for 120/208 volt equipment.
 - 2. Bright red surface with white core for all equipment related to fire alarm systems.
 - 3. Burgundy surface with white core for all equipment related to security systems.
 - 4. Brown surface with white core for all equipment related to data systems.
 - 5. Green surface with white core for all equipment related to TV or sound.
- B. All empty conduit runs and conduit with conductors for future use shall be identified for use and shall indicate where they terminate. Identification shall be by phenolic tags with wire attached to conduit or outlet.
- C. All outlet boxes, junction boxes and pull boxes shall have their covers and exterior visible surfaces painted with colors to match surface color scheme outlined above. This includes covers on boxes above all type ceilings.

2.2 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.
- C. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch (6.4-mm) grommets in corners for mounting. Nominal size, 7 by 10 inches (180 by 250 mm).

- D. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch (6.4-mm) grommets in corners for mounting. Nominal size, 10 by 14 inches (250 by 360 mm).
- E. Fasteners for Signs: Pop-rivets, self-tapping (if screw end is protected), stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.
- F. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 mm)."
- G. **The contractor shall install Arc-Flash warning labels that will be created by the Designer. The contractor shall provide proposed distances for feeders/circuits to the Designer for this analysis prior to beginning any conduit installation and after feeders are installed.**

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Nameplates shall be securely attached to equipment with self-tapping stainless steel screws with screw end protected, and shall identify equipment controlled, attached, etc. Letters shall be 1/2 inch high minimum. Embossed, self-adhesive plastic tape is NOT acceptable for marking equipment.
- B. Refer to specific detail sheets in the Drawings for specific information required on all nameplates or other labeling.

END OF SECTION 260553

SECTION 262726 - WIRING DEVICES

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-box motion sensors.
 - 2. Snap switches and wall-box dimmers.
 - 3. Wall-switch and exterior occupancy sensors.
 - 4. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for pre-marking wall plates.
- C. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.4 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
 - 1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
 - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 - 3. Leviton Mfg. Company Inc. (Leviton).
 - 4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: US Federal specification W-C-596 with hex head grounding screw complying with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
- B. Tamper-Resistant Arc-Fault Convenience Receptacles, 125 V, 20 A Straight Blade Feed Thru: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498. TO BE PROVIDED IN ALL LIVING SPACES.

2.3 GFCI RECEPTACLES

- A. General Description: Straight blade, feed-through type. US Federal specification W-C-596 with hex head grounding screw complying with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

2.4 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20. Provide for quiet operation without the use of mercury switches.
- B. Switches, 120/277 V, 20 A:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
 - b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
 - c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
 - d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).
 - e. Leviton AF series: 20 amperes and providing arc-fault protection to down stream lighting circuits.

2.5 OCCUPANCY SENSORS

- A. Wall-Switch Sensors:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; WS1277.
 - b. Leviton; ODS 10-ID.
 - c. Pass & Seymour; WS3000.
 - d. Watt Stopper (The); WS-200.
 - 2. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m).

2.6 WALL-BOX DIMMERS

- A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

- B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.
- C. Dimmer Switches: Modular; compatible with dimmer ballasts OR LED Drivers; dimmer-ballast/driver combination capable of consistent dimming with low end not greater than 10 percent of full brightness.

2.7 FLOOR SERVICE FITTINGS (TYPE PT)

- A. Flush-Type Floor Service Fittings:
 - 1. Description: Type: Modular, flush-type, dual-service units suitable for wiring method used, with cover flush with finished floor. Size as noted on the drawings.
 - 2. Fire Protection Requirements: Provide a 2-hr fire penetration seal in accordance with the NEC, in the existing floor system.
 - 3. Compartments: Barrier separates power from voice and data communication cabling.
 - 4. Service Plate and Cover: Rectangular, die-cast aluminum with satin finish.
 - 5. Power Receptacle: Two (2) 20 ampere 120 volt receptacles.
 - 6. Data Communication Outlet: Blank cover with bushed cable opening.

2.8 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: 0.035-inch- (1-mm-) thick, satin-finished stainless steel
 - 3. Material for Unfinished Spaces: Galvanized steel.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.
- C. Indoor protective receptacle cover. Clear plastic in-use type cover.

2.9 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
 - 1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.
 - 2. Wiring Devices Connected to Emergency Power System (Life Safety): Red
 - 3. Wiring Devices Connected to Emergency Power System (Standby Power): As selected by Owner/Architect, unless otherwise indicated or required by NFPA 70 or device listing.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
 - 1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 - 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
 - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 - 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
 - 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailing existing conductors is permitted provided the outlet box is large enough.
- D. Device Installation:
 - 1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
 - 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 - 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 - 4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
 - 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
 - 6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.

7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

F. Exterior Installations: Provide weatherproof PVC cover plates, standard size, "ganged" as required and third party listed. Device cover plates shall be "rain-tight" and lockable when in use as required by the National Electrical Code.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

END OF SECTION 262726

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SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

- 1.1 Related Documents: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division - 1 Specification sections, apply to the work of this section.
- 1.2 Switches referred to as disconnect switches on the drawings shall be safety switches.

PART 2 - PRODUCTS

2.1 SAFETY SWITCHES

- A. Safety switches shall be the enclosed, heavy-duty type (type HD) with quick-make, quick-break mechanism and external pad-locking operating handle with "self-defeat" mechanism for opening cover.
- B. Safety switches shall be rated for 250 or 600 volts as applicable. They shall be horsepower rated when used in motor circuits.
- C. Safety switches shall be fusible or nonfusible, 2, 3, or 4 pole as indicated on drawings. Fused safety switches shall have rejection type reinforced fuse clips with type RK time delay dual element fuses equal to Buss "Low-Peak" or Shawmut "Amp-Trap", or approved equal.
- D. Safety switches shall be single throw unless otherwise indicated on the drawings.
- E. Enclosures shall be NEMA 1 indoors and NEMA 3R outdoors unless otherwise indicated on the drawings.
- F. Manufacturer shall be General Electric, Square-D, or Cutler-Hammer, all equipment by one manufacturer.
- G. Safety switches for air conditioning units shall be compatible with UL listing for equipment.
- H. Fuses for HVAC condensing units shall be Class K5, UL listed with an interrupting rating of 50k.
- I. All safety switches shall be provided with two (2) auxiliary contacts integral to the switch that change position with a change in position of the operating handle.

2.2 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

3. Square D; a brand of Schneider Electric.
- B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- D. Features and Accessories:
 1. Standard frame sizes, trip ratings, and number of poles.
 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
 3. Ground and neutral kits.

PART 3 - EXECUTION

- 3.1 Mount enclosed switches securely 54" above floor unless otherwise indicated on the drawings.
- 3.2 Furnish fuses for fusible switches. Fuse sizes indicated on the drawings are provided for bidding purposes and are based on the equipment specified in other divisions of these specifications. Fuse sizes shall be based on the nameplate data of the equipment actually installed.
- 3.3 All equipment shall be located and installed so that it will be readily accessible for operation and maintenance.

END OF SECTION 262816

SECTION 265100 – INTERIOR LIGHTING

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 the work of this section.
- B. 2012 North Carolina Energy Code.

1.2 SUMMARY

- A. This section includes the supply and installation of fixtures, supports, lamps, ballasts and accessories, and supply of plaster frames, trim rings and backboxes for plaster or drywall ceilings or concrete.

1.3 COORDINATION

- A. Confirm compatibility and interface of other material with luminaire and ceiling system. Report discrepancies to the Engineer, and defer ordering until clarified.
- B. Supply plaster frames, trim rings and backboxes to other trades.
- C. Coordinate with other Divisions to avoid conflicts between luminaires, supports, fittings, and mechanical equipment.

1.4 LUMINAIRE DESIGNATION

- A. Furnish, assemble, install and connect all lighting fixtures for outlets shown on the drawings. Fixtures shall be as indicated in the LIGHTING FIXTURE SCHEDULE as shown on the drawings.
- B. All fixtures shall be furnished complete with sockets, lamps, internal wiring, leads, trims, hangers, supports, frames, ballasts, etc., as applicable and required for a complete and workmanlike installation.

1.5 DEFINITIONS

- A. Emergency Lighting Unit: A fixture with integral emergency battery power supply and the means for controlling and charging the battery. They are also known as an emergency light set.
- B. Fixture: A complete lighting unit, exit sign, or emergency lighting unit. Fixtures include lamps and parts required to distribute the light, position and protect lamps, and connect lamps to the

power supply. Internal battery powered exit signs and emergency lighting units also include a battery and the means for controlling and recharging the battery. Emergency lighting units are available with and without integral lamp heads and lamps.

- C. Luminaire: Fixture.
- D. Average Life: The time after which 50 percent will have failed and 50 percent will have survived under normal conditions.

1.6 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data describing fixtures, lamps, ballasts, and emergency lighting units. Arrange product data for fixtures in order of fixture designation. Include data on features and accessories and the following information:
 - 1. Outline drawings of fixtures indicating dimensions and principal features.
 - 2. Electrical ratings and photometric data with specified lamps and certified results of independent laboratory tests.
 - 3. Data on batteries and chargers of emergency lighting units.
- C. Maintenance data for products for inclusion in Operating and Maintenance Manual specified in Division 1.
- D. Product certifications signed by manufacturers of lighting fixtures certifying that their fixtures comply with specified requirements.
- E. Shop drawings from manufactures detailing nonstandard fixtures and indicating dimensions, weights, methods of field assembly, components, features, and accessories.
- F. Coordination drawings for fixtures mounted on, in, or above the ceiling indicating coordination with ceiling grids and other equipment installed in the same space.

1.7 QUALITY ASSURANCE

- A. Listing and Labeling: Provide fixtures, poles/standards and emergency lighting units that are listed and labeled for their indicated use on the Project.
 - 1. Special Listing and Labeling: Provide fixtures for use in damp or wet locations, underwater, and recessed in combustible construction specifically listed and labeled for such use. Provide fixtures for use in hazardous (classified) locations that are listed and labeled for the specific hazard.
 - 2. The terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.

3. Listing and Labeling Agency Qualification: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- B. Manufacturers Qualifications: Firms experienced in manufacturing fixtures that are similar to those indicated for this Project and that have a record of successful in-service performance.
- C. Coordination of Fixtures With Ceiling: Coordinate fixtures mounting hardware and trim with the ceiling system.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.
 1. Warranty Period for Luminaires: Five years from date of Final Acceptance.
 2. Warranty Period for Metal Corrosion: Five years from date of Final Acceptance.
 3. Warranty Period for Color Retention: Five years from date of Final Acceptance.
 4. LED Luminaire Warranty:
 - a. Provide a comprehensive written 5-year warranty for including luminaire finish, on-site replacement of material, and workmanship. On-site replacement includes transportation, removal, and installation of new products. Finish warranty shall include warranty against failure or substantial deterioration such as blistering, cracking, peeling, chalking, or fading.
 - b. Provide a written 5-year replacement material warranty for defective or non-starting LED source assemblies.
 - c. Provide a written 5-year replacement material warranty on all PSUs.
 - d. Provide a written 5-year replacement warranty for non-maintained illuminance levels on all light sources (LED package, LED array, or LED module) including, but not limited to the LED die, encapsulate, and phosphor. If the expected useful life of the luminaire system as defined in this specification is not maintained, then the manufacturer shall replace the light source(s) or luminaire as needed.
 - e. Provide a written 5-year warranty that LED color shift from initial shall color be less than 0.007 on the CIE 1976 (u',v') diagram

1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. LED Modules: 5 for every 100 of each type and rating installed. Furnish at least five (5) of each type.
2. Drivers: 5 for every 100 of each type and rating installed. Furnish at least five (5) of each type.
3. Fixture Types: one (1) of each type.

PART 2 - PRODUCTS

2.1 FIXTURES, GENERAL

- A. Comply with the requirements specified in the Articles below and the lighting fixture schedule on the drawings.

2.2 FIXTURE COMPONENTS, GENERAL

- A. Metal Parts: Free from burrs and sharp corners and edges.
- B. Sheet Metal Components: Steel, except as indicated. Components are formed and supported to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating and free from light leakage under operating conditions. Arrange to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in the operating position.
- D. Reflecting Surfaces: Minimum reflectances as follows, except as otherwise indicated:
 1. White Surfaces: 85 percent.
 2. Specular Surfaces: 83 percent.
 3. Diffusing Specular Surfaces: 75 percent.
 4. Laminated Silver Metallized Film: 90 percent.
- E. Lenses, Diffusers, Covers, and Globes: 100 percent virgin acrylic plastic or water white, annealed crystal glass except as indicated.
 1. Plastic: Highly resistance to yellowing and other changes due to aging, exposure to heat and UV radiation.
 2. Lens Thickness: 0.125 inches, minimum.

2.3 SUSPENDED FIXTURE SUPPORT COMPONENTS

- A. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fitting and ceiling canopy. Finish same as fixture.

- B. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy arranged to mount a single fixture. Finish same as fixture.
- C. Rod Hangers: 3/16-inch diameter cadmium plated, threaded steel rod.
- D. Hook Hanger: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking- type plug.

2.4 LED LIGHTING

A. General:

- 1. LED light fixtures shall be in accordance with IES, NFPA, UL, as shown on the drawings, and as specified.
- 2. LED light fixtures shall be Reduction of Hazardous Substances (RoHS)-compliant.
- 3. LED drivers shall include the following features unless otherwise indicated:
 - a. Minimum efficiency: 85% at full load.
 - b. Minimum Operating Ambient Temperature: -20° C. (-4° F.)
 - c. Input Voltage: 120 - 277V (±10%) at 60 Hz.
 - d. Integral short circuit, open circuit, and overload protection.
 - e. Power Factor: ≥ 0.95.
 - f. Total Harmonic Distortion: ≤ 20%.
 - g. Comply with FCC 47 CFR Part 15.
- 4. LED modules shall include the following features unless otherwise indicated:
 - a. Comply with IES LM-79 and LM-80 requirements.
 - b. Minimum CRI 80 and color temperature 3000° K unless otherwise specified in LIGHTING FIXTURE SCHEDULE.
 - c. Minimum Rated Life: 50,000 hours per IES L70.
 - d. Light output lumens as indicated in the LIGHTING FIXTURE SCHEDULE.
- 5. Provide 2.5kV surge suppression on all interior luminaires and 10 kV surge suppression on all exterior luminaires.

B. LED Downlights:

- 1. Housing, LED driver, and LED module shall be products of the same manufacturer.

2.5 EMERGENCY LIGHTING UNITS

- A. It shall be completely self-contained, provided with 12 volt maintenance-free battery, automatic charger, and other features. Luminaire must be third party listed as emergency lighting equipment, and meet or exceed the following standards; NEC, N.C. Building Code, Energy Code, NFPA-101, and NEMA Standards.

- B. The battery shall be sealed, maintenance-free type, with minimum of 90 minutes operating endurance. Must have a normal life expectancy of 10 years. Batteries shall be a high temperature type with an operating range of 0 degree C to 60 degrees C and contain a resealable pressure vent, a sintered + positive terminal and - negative terminal.
- C. The charger shall be fully automatic solid state type, full wave rectifying, with current limiting. Charger shall restore the battery to its full charge within 24 hours after a discharge of 90 minutes under full rated load. The unit shall be activated when the voltage drops below 80 percent. A low voltage disconnect switch shall be included if LEAD Battery is used, to disconnect the battery from the load and prevent damage from a deep discharge during extended power outage. Additional features shall include a pilot light to indicate the unit is connected to AC power. The unit shall be provided with self-diagnostics and will perform all tests required by NFPA 101 and UL 924. The unit will automatically test the battery capacity every thirty days for 30 seconds. It will perform a full battery capacity test for 90 minutes, randomly within each 6-month period. The unit continuously monitors the condition of the circuit board and lamps. If a circuit failure occurs that turns off the lamps or the battery charger circuit fails, then a circuit failure will be indicated by the indicator blinking three times. If one or more of the lamps in the EMERGENCY FIXTURE fail, the diagnostic LED will indicate a lamp failure by blinking four times. A test switch to simulate the operation of the unit upon loss of A.C power by energizing the lamps from the battery. This simulation must also exercise the transfer relay.
- D. The entire unit shall be warranted for three years. The battery must have an additional two more years pro-rated warranty. Warranty shall start from the date of project final acceptance. Warranty shall be included in the contract document.
- E. The Contractor shall perform a test on each unit after it is permanently installed and charged for a minimum of 24 hours. Battery shall be tested for 90 minutes. The battery test shall be done 10 days prior to final inspection by the Designer. **This test should take place at night or the contractor shall simulate a condition where no ambient light is available.** Any unit which fails the test must be repaired or replaced, and tested again. The test shall also verify compliance with NEC-700. 12 (F), therefore contractor shall test initial footcandle levels as well as the footcandle levels at the end of the 90 minute period as well as voltage levels at the battery terminals. Copy of the test report shall be sent to the Designer for review prior to the final inspection.

2.6 EXIT SIGNS

- A. It shall be completely self-contained. Luminaire must be third party listed as emergency lighting equipment, and meet or exceed the following standards; NEC, N.C. Building Code, NFPA-101, and NEMA Standards.
- B. The entire unit shall be warranted for three years. Warranty shall start from the date of project final acceptance. Warranty shall be included in the contract document. The use of LED is required due to their reliable performance, low power consumption, and limited maintenance requirements. Maximum LED failure rate shall be 25% within a seven (7) year period;

otherwise, if exceeded, manufacturer shall replace the complete unit at no charge to the owner.

2.7 LED Emergency Egress Luminaires

Provide unitary emergency egress luminaires with maintenance-free battery, automatic charger, and two lighting heads. Luminaire shall be third-party listed as emergency lighting equipment, and meet or exceed the standards noted above and the following standards.

- A. Provide battery voltage as recommended by luminaire manufacturer for LED light source.
- B. Square wave inverters shall not be used with LED emergency egress lighting. Sinusoidal wave inverters are the preferred method.

1. LED Emergency Egress Luminaires for Normal lighting with Integral Emergency Batteries

2. Additional Features

Pilot light to indicate the unit is connected to AC power. The battery shall have high rate charge pilot light, and self-diagnostic functions. A test switch to simulate the operation of the unit upon loss of AC power by energizing the lamps from the battery. This simulation must also exercise the transfer relay. Provide a switch accessible without removing covers or opening the fixture.

3. Battery for Emergency Egress Luminaires

For unitary emergency lighting, provide maintenance free battery, with minimum of 90 minutes operating endurance and a normal life expectancy of 10 years. Batteries shall be a high temperature type with an operating range of 0oC to 60oC and contain a resealable pressure vent, a sintered + positive terminal, and a - negative terminal.

For normal lighting fixtures with integral batteries, provide maintenance free batteries with minimum 90 minutes operating endurance, normal life expectancy of 5 years, and listed for use with the associated fixture. Provide minimum 5 year full warranty with an additional 2 more years prorated warranty.

4. Charger

Provide fully automatic solid state type, full wave rectifying, with current limiting. Charger shall restore the battery to its full charge within 24 hours after a discharge of 90 minutes under full rated load. The unit shall be activated when the voltage drops below 80%. A low voltage disconnect switch shall be included if a battery is used, to disconnect the battery from the load and prevent damage from a deep discharge during extended power outage.

5. Warranty

The entire unit shall be warranted for minimum five years. The battery must have a 3 year warranty with an additional 3 more years pro-rated warranty. Warranty shall start from the date of project final acceptance. Warranty shall be included in the contract documents.

6. Unit Test

Contractor shall perform a test on each unit after it is permanently installed and charged for a minimum of 24 hours. Battery shall be tested for 90 minutes, in accordance with NEC 700. Any unit which fails the test must be repaired or replaced, and tested again. Copy of the test report shall be available at final inspection and shall be included in owner's operation and maintenance manual. Include either starting voltage, ending voltage, and percent voltage drop or starting lumens, ending lumens, and percent lumens drop in the test report

2.8 FINISH

- A. Steel Parts: Manufacturer's standard finish applied over corrosion-resistant primer, free of streaks, runs, holidays, stains, blisters, and defects. Remove fixtures showing evidence of corrosion during project warranty period and replace with new fixtures.
- B. Other Parts: Manufacturer's standard finish.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Setting and Securing: Set units plumb, square, and level with ceiling and walls, and secure according to manufacturer's printed instructions and approved shop drawings.
- B. Support For Recessed and Semirecessed Fixtures: **Reference Drawings for specific details.**
- C. Support for Suspended Fixtures: Brace pendants and rods that are 4-feet long or longer to limit swinging. Support stem mounted single-unit suspended fluorescent fixtures with twin-stem hangers. For continuous rows, use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of chassis, including one at each end.
- D. Lamping: Lamp units according to manufacturer's instructions.

3.2 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Give advance notice of dates and times for field tests.
- C. Provide instruments to make and record test results.
- D. Replace or repair malfunctioning fixtures and components, then retest. Repeat procedure until all units operate properly.

3.3 ADJUSTING AND CLEANING

- A. Clean fixtures upon completion of installation. Use methods and materials recommended by manufacturer.
- B. Adjust aimable fixtures to provide required light intensities.

3.4 Verify with the Contractor the type of ceilings which will be used in the various spaces before ordering fixtures, to ensure compatibility with the ceiling types to be actually installed, including trim and accessories.

3.5 Mounting heights of fixtures are, in most cases, indicated on the drawings or scheduled. Where job conditions require mounting heights different from those shown or specified to avoid equipment, structural features, etc., such changes in mounting height shall be as directed without additional cost to the Owner.

3.6 The work of this Section shall include the careful examination of the Architectural and Mechanical drawings as to become acquainted with the structural features of the building, and the location of pipe and ductwork which would alter the location and spacing of outlets for fixtures. Where conflicts develop, same shall be referred to the Engineer for a decision as to the proper location. The work of this Section shall also include responsibility for the proper reinforcement of any ductwork necessary to carry the added weight of lighting fixtures where same must be supported by such ductwork.

3.7 Attention is directed to the possible close fit requirements of some lighting fixtures within bar joist areas. All fixtures for these areas shall be closely coordinated with bar joist locations for proper fit and alignment.

END OF SECTION 265100

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SECTION 270533 – CONDUITS AND OUTLET BOXES FOR COMMUNICATION SYSTEMS

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 the work of this section.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Materials. The materials used for this system are generally NOT manufacturer and part number specific. Equivalent, high quality materials may be utilized without submittals to NCSU ComTech. However, the university reserves the right to reject materials that are considered of substandard quality. See Section 27 06 00 Schedules for Communications Systems for a list of materials acceptable for use in NC State University projects.

PART 3 - EXECUTION

3.1 MATERIALS AND STANDARDS

- A. Construction details. Detail drawings describing various outlet box and conduit systems are available for download and modification by designers at the ComTech website.
- B. Standards. All work shall be in accordance with the latest edition of all applicable campus, State, and Federal regulations and codes. Special considerations should be made to comply with NEC, NFPA, and North Carolina State Construction Office requirements. All work shall also be in accordance with the latest versions of the BICSI TDMM manual and TIA-569 standard, and with manufacturer's recommendations.
- C. Fire safety considerations. The installation of outlet boxes and conduits shall comply with all applicable fire safety and electrical codes. In general, the North Carolina State Construction Office determines the compliance of these systems with codes, and they reserve the right to inspect and approve/disapprove their installation. The horizontal pathway system shall be a completely enclosed, metallic system from the BDF/IDF to the outlet. It will be used to house non-plenum rated cables. All conduit penetrations of rated walls and floors shall be firestopped per applicable UL assembly.
- D. Enclosed pathways. Each of these pathway systems shall be a completely enclosed, metallic system. Typically, the horizontal pathway system consists of outlet boxes at the work space location connected to a nearby wireway via 1" metal (EMT) conduit.

- E. Outlet placement. Typically, all outlets are installed at 18" AFF. For aesthetics purposes in new construction, the bottom of the outlet box should be installed even with the bottom of electrical receptacle boxes. Outlet boxes may be mounted higher if necessary to be located above furniture, counter tops, or equipment. Outlet boxes should not be located too close to wet areas (e.g. sinks) where faceplates or patch cords could come into contact with water. Boxes also should not be located too close to sources of excessive heat, dust, chemicals, or electromagnetic interference (EMI).

Outlet boxes should also be located so that they will be accessible to technicians for patch cord installation or for jack retermination even after furniture and equipment is installed. Boxes should not be installed behind heavy equipment or modular furniture panels. Ergonomics and egress factors should be considered when planning outlet locations. Outlets should be located so as not to require telephone or data patch cords to be installed across doorways, aisles, or other "people" traffic areas.

- F. Outlet box type. Wall construction type normally determines the type of outlet box to be installed.

Flush mounted outlet boxes should be installed in all walls of gypboard and standard stud (3 5/8" deep) construction. The top and bottom flanges (ears) of old work boxes should be adjusted so that the box itself does not protrude at all beyond the surface of the gypboard. In general, flush mounted outlet boxes should be installed exactly straight (perpendicular to walls and floor) and flush with the surface of the gypboard (after plaster ring installation). No visible gaps between the edge of the faceplate and the gypboard should be present after final installation. Conduit is to be installed so as to enter the top of the box, into one of the back knockouts.

Surface mounted outlets should be installed onto all other wall types (masonry, plaster, prefabricated wall panels, etc.). In most cases these outlets will consist of a standard surface mounted outlet box with a surface mounted 1" conduit routed up the wall to the nearest wireway. The conduit and outlet box should be painted to match the surrounding wall surface. In cases where aesthetics are of concern, the 1" conduit may be replaced with Wiremold 2400 metal raceway. The raceway and box may or may not be painted to match the surrounding wall surface. For cleanest appearance, a bead of latex caulk should be applied between the wall and each side of the 2400 raceway.

- G. Conduit requirements. The length of flexible conduit installed in the ceiling area should be minimized. Flex conduit should be transitioned to EMT immediately after it exits the hollow wall with the flex conduit supported at its exit from wall. Conduits should be installed with appropriate offsets (box kicks) where they are connected to outlet boxes and junction boxes to keep surface mounted conduits flush against walls and decks.

A maximum of 180 degrees between pull points shall be maintained in all conduit runs. This does not include the box kicks described above. No LB-type (or similar) condulets shall be used. Use junction boxes to create pull points. These should be placed in straight sections of conduits where possible, but may be used to replace conduit bends where bends are impractical. When junction boxes are used in lieu of bends, the conduits should be connected to the junction box with maximum separation to allow the maximum cable radius within the box as possible. Only compression connectors and couplings shall be used in all conduit runs. No set screw connectors and couplings shall be used.

- H. Support structures. Outlet conduits are usually fastened to nearby walls or decks with one- hole straps. Surface mounted conduit hangers “mineralac straps” will not be used where visible. Conduit hangers with threaded rod used for overhead support may be used.

Each conduit shall be supported within 3’ from where it connects to a wireway, junction box, or outlet box. The conduit shall be supported at intervals not exceeding 5’ in the remainder of its run. Multiple conduits may be supported by a trapeze. No conduit shall lie directly on top of an acoustic tile ceiling grid or be supported by the grid or the grid supports (wire).

- I. Direct conduit systems. By default, 1” conduit runs from outlets should be connected to the wireway system and not be directly routed to the IDF. However, for IDFs serving a very small number of outlets or a very small geographic zone, a wireway system may not be necessary. In these cases, all of the 1” conduits may be installed in a homerun fashion directly back to the IDF. The conduits should penetrate the wall of the IDF and be terminated with a conduit connector (no plastic bushing needed). As much as possible, the conduits should be terminated near the corners of the IDF to facilitate cable routing. Conduits that penetrate the IDF between 7’- 6” and 9’- 0” may be terminated horizontally on the wall. Conduits that penetrate above 9’- 0” should be turned down vertically and terminated above 7’- 6”. Conduits that penetrate below 7’- 6” should be turned up vertically and terminated above 7’- 6”.

Occasionally, with IDFs equipped with a wireway system, it is impractical to route particular 1” conduits to the wireway. These can be routed directly to the IDF per the above guidelines.

- J. SSI outlets. SSI-A outlets consist of two standard surface mount outlet box installed inside a 10”x 10”x 6”D screw cover junction box. Boxes are connected to each other via a conduit nipple. The upper outlet box is then connected to the nearest wireway via 1 ½” conduit. SSI-B boxes are similar except they house only one surface mount outlet box inside an 8”x 8”x 6”D junction box. The outlet box is connected to the wireway by 1” conduit.
- K. Aesthetics. Generally, all visible conduits should be painted to match surrounding surfaces. Conduits installed in locations not visible by building occupants do not require painting. Ideally, all elements of the horizontal pathway system except for the actual outlet boxes in work spaces will be completely hidden from view. However, if this is not possible, the designer should carefully determine routing and components used to minimize negative aesthetics impacts.

END OF SECTION 270533

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SECTION 270536 – RACEWAYS FOR COMMUNICATION SYSTEMS

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 the work of this section.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Pathway systems. A horizontal pathway system will be installed in campus buildings to route and protect all telecommunications cabling from the BDF/IDF to the outlets in all work space locations. A network of wireways installed throughout the interior of campus buildings is part of this system. A separate riser pathway system will be installed to route and protect all telecommunications cabling to link the BDF to all IDFs.
- B. Materials. The materials used for this system are generally NOT manufacturer and part number specific. Equivalent, high quality materials may be utilized without submittals to NCSU ComTech. However, the university reserves the right to reject materials that are considered of substandard quality. See Section 27 06 00 Schedules for Communications Systems for a list of materials acceptable for use in NC State University projects.

PART 3 - EXECUTION

3.1 MATERIALS AND STANDARDS

- A. Standards. All work shall be in accordance with the latest edition of all applicable campus, State, and Federal regulations and codes. Special considerations should be made to comply with NEC, NFPA, and North Carolina State Construction Office requirements. All work shall also be in accordance with the latest versions of the BICSI TDMM manual and TIA-569 standard, and with manufacturer's recommendations.
- B. Fire safety considerations. The installation of raceways and conduits shall comply with all applicable fire safety and electrical codes. In general, the North Carolina State Construction Office determines the compliance of these systems with codes, and they reserve the right to inspect and approve/disapprove their installation. The horizontal pathway system shall be a completely enclosed, metallic system from the BDF/IDF to the outlet. The riser pathway system shall be a completely enclosed metallic conduit system between the BDF and all IDFs. Both will be used to house non-plenum rated cables. All conduit penetrations of rated walls and floors shall be firestopped per applicable UL assembly.

- C. Horizontal pathway sizes. Typically the horizontal pathway system will consist of a network of wireways installed in the ceiling areas of the building with 1" conduits run to each work space outlet. See Section 27 05 33 Conduits and Outlet Boxes for Communication Systems. The designer should determine the cross-sectional area required for each separate section of wireway, and specify sizes on the drawings. All horizontal cabling is run in a star topology (homerun) from each outlet back to the nearest IDF. Therefore, the required cross-sectional area of the system increases as it gets closer to the IDF. A general rule of thumb is to plan for 1 sq. in. of cross-sectional area for each outlet to be installed. The area should be increased an additional 20% above initial installation for anticipated growth.
- D. Riser pathway sizes. The riser pathway system connecting IDFs to the BDF will typically consist of a series of 4" conduits. For a building with a BDF and a "stack" of three IDFs or less, two 4" conduits are adequate. For larger installations additional conduits will be required. Cabinet type IDFs will require a single 2" conduit from the BDF.
- E. Horizontal system topology. The horizontal pathway system will consist of a series of enclosed wireways radiating from each IDF or BDF. Larger wireways will be installed from the IDF/BDF to provide access to all general areas of its geographic zone. Smaller, lateral wireways will branch off from the larger wireways to extend the pathway system to all occupied areas of the building.
- F. Maximum horizontal pathway length. The maximum length of the horizontal cable channel is limited to 295 ft. (90m). Since this channel includes patch cords at the outlet and in the IDF and also the cable slack loop installed in the IDF, the actual length of the horizontal pathway is somewhat shorter. A good rule of thumb to use in designing these pathways is the "250 ft. rule". The pathway run from the outlet box farthest from an IDF back to where the wireway penetrates the wall of that IDF should not exceed 250 ft. It is imperative that this calculation includes allowances for the vertical conduit run from the wireway to the outlet box and for the vertical and horizontal deviations in the wireway routing.
- G. Routing. Typically, wireways are routed in corridors or other publicly accessible areas of the building. Normally, they are routed in the ceiling areas, above acoustic tile ceilings when possible. Routing of wireways through occupied spaces is discouraged, but may be required due to utility conflicts or hard ceilings.

Riser conduits may be routed anywhere in a building since they are almost never accessed by technicians. It may be advantageous to route these in spaces other than corridors since corridor ceilings are usually crowded with other utilities.

Also, there are areas of buildings that should typically not be used for wireway or conduit routing. These include:

1. Stairwells.
2. Elevator shafts and equipment rooms.
3. Outdoor areas (including covered breezeways) where moisture may be present. The cabling to be installed has no water resistance characteristics.
4. Wet areas inside buildings such as shower facilities, equipment wash down areas, steam rooms, etc.
5. Hazardous locations. Since the wireways need to remain accessible for technicians to install cabling on an ongoing basis, routing through areas exposing personnel to

- dangerous heights, high voltage equipment, hazardous chemicals, etc. should be avoided.
6. Locations with excessive heat. The cabling to be installed in these pathway systems is not designed to withstand excessive heat. Wireways and conduits should be routed to avoid heat sources hot enough to cause sheath deformation over time in the cables.
 7. Confined spaces. Wireways should not be routed in spaces that are designated as confined spaces requiring special permitting or safety precautions for entry.
 8. EMI sources. Wireways and conduits should be located away from extraordinary sources of electromagnetic interference (EMI).
- H. Access. In areas of buildings where acoustic tile ceilings are present, the wireway system is typically installed between the top of the grid and the deck above. In these applications, the bottom of the support structure (trapeze) should be installed at least 3" above the grid. In areas without acoustic tile ceilings, the wireway system should be installed exposed with the bottom of the support structure at least 8'- 6" AFF. Wireways should not be installed above inaccessible (hard) ceilings.

The wireways should be installed to maximize accessibility for future cable and conduit installations. A minimum of 24" accessible workspace should be maintained in front of the wireway cover. Also, at least one side panel of each 45 degree elbow should be accessible for removal and for cable installation.

Where wireways penetrate walls or other obstructions preventing their removal, the covers should be cut to allow maximum access to the interior of the wireway. Sharp edges and burrs should be filed smooth on edges of cut covers to prevent damage to cables or injuries to technicians. It is also acceptable to install the cover on one side of one section of wireway and install the cover on the opposite side of the next section of wireway to maximize access.

- I. Wireway requirements. All wireways should be installed with as few turns as possible. 90 degree turns in the wireway should be installed using two 45 degree elbows. Wireway runs with a significant number of turns and offsets should be enlarged to the next trade size to maintain cable carrying capacity. Screw cover wireway is to be used in all locations. The cover should be installed on either side of the wireway (not on the top or bottom sides). Conduits from outlets should be connected to either the top or the back side (side opposite the cover) of the wireway. Conduits should not be connected to the bottom or directly to the cover of the wireway without the approval of ComTech. If conduits are connected to the wireway cover, the cover should be cut 3" to each side of conduit, deburred, and screwed shut. All covers to be installed with hand tightened screws. No power drills or screw drivers are to be used.
- J. Conduit requirements. A maximum of 180 degrees between pull points should be maintained in all conduit runs. For 4" riser conduits, install 48" long sections of 6"x 6" wireway in straight sections of the conduit runs to create pull points. The 4" conduits should be connected to the end cap of each end of the above wireway sections. Plastic bushings are required on all conduit ends. These pull points should be located to provide the maximum possible access for cable installation by technicians. Junction boxes should not be installed in lieu of conduit bends without the approval of ComTech.
- K. IDF penetrations. Wireways should penetrate directly into IDFs horizontally (without transitioning to conduit) at 8'- 0" AFF minimum. The ideal penetration height for wireways is 9'- 0" AFF. Each wireway should be stubbed into the room approximately 4" and turned down with a single 45

degree elbow installed onto the end of the horizontal wireway. If installation of this elbow is not practical, plastic channel should be installed to all four edges of the wireway end with permanent glue. Wireways serving floors below should be stubbed directly into the IDF 4" AFF (without transitioning to conduit). Wireways serving floors above should penetrate the ceiling of the IDF and terminate vertically at 9'- 0" AFF. Plastic channel should be installed on all non-factory (cut) edges.

Riser conduits that penetrate the floor of the IDF from below should be stubbed into the IDF 4" AFF. Riser conduits that penetrate the ceiling of the BDF/IDF from above should be terminated vertically at 10'- 0" AFF.

- L. Cabinet connections. For cabinet type IDFs, all conduits should be connected directly to the junction box (shared with horizontal cables) mounted above the cabinet.
- M. Support structures. Overview. The structures installed to support the pathway systems must be adequate to support the weight of the pathway components, the weight of the cables, and the force exerted on the pathway system during cable pulling operations. The support system must be adequately anchored into the surrounding building structure. A variety of support structure components may be used as dictated by site specific conditions. However, all components shall be supported per NEC codes or per these guidelines, whichever is stricter.
 - 1. Wireway. The most common methods of supporting wireway are:
 - a. Trapeze. These structures consist of 1 ½" steel channel installed below and fastened to the wireway and supported with two 3/8" threaded rods run vertically from the channel to the deck or support beams above. One threaded rod is run on each side of the wireway.
 - b. Wall brackets. These are "L" brackets fastened to the bottom of the wireway and to an adjacent wall.
 - 2. Riser conduits. Conduits that are run horizontally will be supported with the same trapeze type structure described above. Riser conduits run vertically will be fastened to 1 ½" channel which, in turn, will be fastened to an adjacent wall.
 - 3. Requirements. Wireways and riser conduits shall be supported at intervals not exceeding 5'. Wireways will be supported within 18" of 90 degree turns. Each 10' straight section of wireway shall be supported at least twice. No conduit or wireway shall lie directly on top of an acoustic tile ceiling grid or be supported by the grid or the grid supports (wire). No conduit or wireway shall be supported by the same system used to support any other conduits, piping, ductwork, or other building system or equipment. In addition, no non-communications system components should ever be supported by the communications pathway support system.
 - 4. Anchoring. Suitable anchoring methods must be utilized to fasten pathway support components to the building's structure. Following are some general guidelines regarding anchor installation:
 - a. Masonry walls, decks, and beams. This system involves installing appropriate metal anchors into solid concrete decks or beams or into masonry walls.
 - b. Steel beams and trusses. Installing threaded rods vertically up to beam clamps that are fastened to overhead steel structural elements is an acceptable anchoring practice.

- c. Stud walls. Normally, wireways and riser conduits are not supported from gypboard/plaster and stud construction walls. However, if no overhead support is possible, "L" brackets may be fastened securely to the wall studs. Brackets should not be fastened to the wall surface material only.
 - d. Hard ceilings. Ceilings that are not suspended acoustic tile (gypboard, spline type, etc.) shall not be used to support wireways or riser conduits. Threaded rods may pass through ceilings of this type to reach structural elements above. If these ceilings form part of a fire rated barrier, they must be completely restored to maintain the originally designed rating.
- N. Aesthetics. Generally, all visible system elements should be painted to match surrounding surfaces. Elements installed in locations not visible by building occupants do not require painting. Ideally, all elements of the horizontal and riser pathway systems will be completely hidden from view. However, if this is not possible, the designer should carefully determine routing and components used to minimize negative aesthetics impacts. Historically, false columns, soffits, and archways have been constructed to conceal wireways and conduits in especially sensitive areas of buildings. These structures should be installed in a manner consistent with the visual architecture of the building, while still allowing access for installation of cabling.

END OF SECTION 270536

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SECTION 283111 - DIGITAL ADDRESSABLE FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This Section includes fire alarm systems with manual stations, detectors, signal equipment, controls, and devices and contains all relevant criteria contained in the North Carolina State Construction Office document "Fire Detection and Alarm Systems" dated March 2011.

1.2 SCOPE

- A. This section of the specifications includes the furnishing, installation, and connection of the microprocessor controlled, analog addressable intelligent reporting fire alarm equipment required to form a complete coordinated system ready for operation. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, control panels, auxiliary control devices, annunciators, power supplies, and wiring as shown on the Drawings and specified herein.

1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of fire alarm systems of types, sizes, and electrical characteristics required, and whose products are Listed and Labeled. Products of firms that do not maintain factory authorized service organization and spare parts stock are not acceptable for use on this project.
- B. Acceptable Manufacturers/Models: The University maintains its fire alarm system and as such all systems shall be fully serviceable and programmable by the University. Acceptable manufacturers are limited as follows:
 - 1. Simplex/Grinnell Intelligent Fire Alarm Systems to match existing conditions.
- C. Installer's Qualifications: Company specializing in performing the work of this section and making the final terminations of this section. Minimum of 5 years documented experience installing fire detection and alarm systems similar in size and scope to this project. Qualifications of installer shall be provided with equipment submittal. Installer shall be certified by the manufacturer to install, program and service the system and shall directly supervise the final connections between the equipment and the wiring system.
- D. Only the Installer may make program changes and must be present for the 100% test, Engineer's inspection and Owner inspections. Training certification shall not be more than 2 years old and must be for the equipment model installed on the project.

E. Codes and Standards:

1. NFPA Compliance: Comply with current applicable requirements of NFPA-72, National Fire Alarm Code.
2. NEC Compliance: Comply with current applicable requirements of NFPA-70, National Electrical Code (NEC) standards pertaining to fire alarm systems.
3. Testing Laboratory Compliance: Comply with provisions of UL safety standards pertaining to fire alarm systems. Provide products and components, which are Listed and Labeled.
4. FM Compliance: Provide fire alarm systems and accessories, which are FM approved.

1.4 SUBMITTALS

- A. General: Submittals shall demonstrate compliance with technical requirements by reference to each subsection of this specification. Where a submitted item does not comply fully with each and every requirement of the specifications, the submittal shall clearly indicate such deviations. Identification requirements for non-complying features of items are very specific.

1. Prior to accepting the fire alarm shop drawing package, the Designer shall conduct a mandatory "fire alarm review meeting" with the NCSU construction management team and the Contractor. The electrical contractor and fire alarm contractor shall review the fire alarm shop drawing package with NCSU. The purpose of this meeting is to insure contractor complies with NCSU's site specific fire alarm and detection installation requirements.
2. Product Data: Submit Manufacturer's technical product data, including specifications and installation instructions, for each type of fire alarm system equipment. Submit technical product data on the fire alarm service equipment. Submittals shall provide mA current draw data for each device submitted and UL Listed minimum voltage required to operate. Panel submittal shall list voltage drop allowed for panel and Notification Appliance Circuits (NAC).
Shop Drawings: Submit shop drawings showing equipment, device locations, and connecting wiring of entire fire alarm system. Include wiring and riser diagrams. Copies of Project Construction Documents or details therefore may not be a part of the shop drawing submittal. Provide distance and proposed route for each Notification Appliance Circuit (NAC). Drawings shall include design ambient sound level, audible alarm device sound power and alarm sound level for each space.
Installation Instructions: Submit Manufacturer's detailed installation instruction for all duct mounted smoke detectors, flow switches, tamper switches, supervisory switches, and similar items which require mechanical installation.
3. Battery Calculations: Systems are to be provided with a separate and independent source of secondary power. All shall have a minimum of 60 hours secondary power capacity, plus 15 minutes of full alarm load

Include a copy of system battery sizing calculations with the shop drawing submittal to the engineer. Use manufacturer's battery discharge curve to determine expected battery voltage after 60 hours of providing standby power. Then use calculated Notification Appliance Circuit current draw in the alarm mode to determine expected

voltage drop at EOL, based on conductor resistance per manufacturer's data sheet or NEC 2014, Table 8; add any inherent voltage drop caused by the system's power supply.

The voltage drop at EOL must 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 must be no less than the minimum listed operating voltage for the alarm notification appliances used.

All of these calculations must 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.

4. Maintenance Data: Submit maintenance data and parts lists for each type of fire alarm equipment installed, including furnished specialties and accessories. Include this data, product data, and shop drawings in maintenance manual.
5. Certifications: Submit a certification from the major equipment manufacturer indicating that the proposed supervisor of installation and the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include names and addresses, and telephone numbers in the certification.
6. Qualifications: Submit data to indicate compliance with Quality Assurance requirements for Manufacturer and Installer.

PART 2 - PRODUCTS

2.1 FIRE ALARM CONTROL PANEL (FACP)

- A. FACP - General: Existing to remain 4100ES system.
- B. Signal Line Circuits: Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded onto an NFPA Style 6 (Class A) Signaling Line Circuit (SLC).
- C. Notification Appliance Circuits: Alarm notification appliance (NAC) circuits shall be NFPA 72 Style Y (Class B). The load connected to each circuit must not exceed 80% of rated module output. The NAC voltage drop during alarm must not exceed 14% of the voltage measured across the batteries at that time. The contractor shall use power outage testing to verify that the NAC circuit was designed and installed properly.
- D. Digitized electronic signals shall employ check digits or multiple polling. In general a single ground or open on any system signaling line circuit, initiating device circuit, or notification appliance circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.
- E. Loss of Power: Alarm signals arriving at the main FACP shall not be lost following a power failure (or outage) until the alarm signal is processed and recorded.

- F. System Response to an Alarm Condition: When a fire alarm condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:
1. The system alarm LED shall flash.
 2. A local piezo-electric signal in the control panel shall sound.
 3. The 80-character LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.
 4. History storage equipment shall log the information associated with each new fire alarm control panel condition, along with time and date of occurrence.
 5. All system output programs assigned via control-by-event equations to be activated by the particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.
 6. Activate all fire alarm Notification Appliances in the building, sounding and flashing in synchronization continuously until manually silenced, or until the initiating device and control unit have been reset to normal condition.
 7. Communicate to Owner's Main Network Panel and Communicator.
 8. Deactivate door hold control relay such that all smoke doors are allowed to close.
 9. Deactivate control relays allowing HVAC units to stop.
- G. System Response to Trouble Conditions
1. System AC power trouble signal shall not be sent unless maintained for 6 hours or more. Provide a dual time delay relay with a minimum setting of sixty (60) seconds in the FACP for this purpose.
 2. Provide immediate transmission of all other supervisory signals.
 3. Provide adjustable delay for all other trouble signals prior to transmission.
- H. System Capacity and General Operation: The system shall have the following capacities and general operation modes:
1. The FACP shall provide, or be capable of expansion to 198 intelligent/addressable devices per SLC and 2048 annunciation points per system. The number of SLCs provided shall be as indicated on the Drawings.
 2. The FACP shall include a full featured operator interface control and annunciation panel that shall include a backlit, 80 character liquid crystal display, individual, color coded system status LEDs, and an alphanumeric keypad for the field programming and control of the fire alarm system.
 3. All programming or editing of the existing program in the system shall be achieved without special equipment and without interrupting the alarm monitoring functions of the fire alarm control panel, and shall be password protected.
 4. The FACP shall be able to provide the following features:
 - Upload/Download to PC Computer
 - Alarm Verification with Tally
 - Automatic Day/Night Sensitivity Adjust
 - Charger Rate Control
 - Drift Compensation
 - Device Blink Control

- Pre-alarm Control Panel Indication
 - NFPA 72 Smoke Detector Sensitivity Test
 - System Status Reports
 - Alarm Verification, by device, with tally
 - Multiple CRT Display Interface
 - Non-Alarm Module Reporting
 - Smoke Detector Maintenance Alert
 - Trouble Reminder
 - Walk Test
 - Periodic Detector Test
 - Multiple Printer Interface
 - Security Monitor Points
 - Block Acknowledge
 - Control-By-Time
5. The system shall perform time based control functions including automatic changes of specified smoke detector sensitivity settings.
- I. Audio Amplifiers – Amplifiers shall be suitable for use with power limited wiring systems. All amplifiers shall be the same wattage and size.
- J. Audio One-Way Voice Communications
1. The system software shall be capable of selecting the required audio source signal for amplification. To enhance system survivability, each audio amplifier shall automatically provide an internally generated local 3-3-3, 1000 Hz temporal pattern output upon loss of the audio signal from the one-way emergency audio control unit, during an alarm condition.
 2. Audio amplifiers shall be power limited and protected from short circuits conditions on the audio circuit wiring. Each amplifier output shall be a supervised, dedicated, selectable 25/70 Vrms output.
 3. Provide a standby audio amplifier, per node that will automatically sense the failure of any primary amplifier installed in the same panel and replace the function of the failed amplifier.
- K. Signaling Line Circuit (SLC) Interface Board: The FACP shall contain SLC interface boards as required to communicate with the SLC loops as shown on the Drawings. Each SLC board shall monitor and control a minimum of 198 intelligent addressable devices. This includes 99 analog detectors (Ionization, Photoelectric, or Thermal) and 99 monitor or control modules.
1. Each SLC interface board shall contain its own microprocessor, and shall be capable of operating in a local mode (any SLC input activates all or specific SLC outputs) in the event of a failure in the main CPU of the control panel. The SLC interface board shall not require any jumper cuts or address switch settings to initialize SLC Loop operations. SLC interface boards shall provide power and communicate with all intelligent addressable detectors and modules connected to its SLC Loop on a single pair of wires. This SLC Loop shall be capable of operation as NFPA Style 4, Style 6, or Style 7.
 2. Each SLC interface board shall receive analog information from all intelligent detectors and shall process this information to determine whether normal, alarm, or trouble conditions exist for that particular detector. The SLC interface board software shall include software to automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information may also be used for automatic detector testing and for the automatic determination of detector maintenance requirements.

- L. Serial Interface Board: The FACP shall contain a serial interface board to provide an EIA-232 interface between the fire alarm control panel and the UL Listed Electronic Data Processing (EDP) peripherals. The serial interface board shall allow the use of multiple printers, CRT monitors, and other peripherals connected to the EIA-232 ports. In addition, the serial interface board shall provide one EIA-485 port for the serial connection to annunciation and control subsystem components; LEDs shall be provided to show operational status. All serial interface input/outputs shall be optically isolated to provide protection from surges and/or earth grounds.
- M. Operator's Terminal: Provide an operator's terminal, which allows the following minimum functions. In addition, the operator's terminal shall support any other functions required for system control and/or operation:
 - 1. Acknowledge (ACK/STEP) Switch
 - 2. Signal Silence Switch
 - 3. System Reset Switch
 - 4. System Test Switch
 - 5. Lamp Test Switch
- N. Power Supply: The FACP power supply(ies) shall operate on 120 VAC, 60 Hz and shall have a continuous rating adequate to power all equipment and functions in full alarm continuously. All modules and drivers must be able to withstand prolonged short circuits in the field wiring, either line-to-line or line-to-ground, without damage.
 - 1. The power supply shall provide a battery charger for 60 hours of standby using dual-rate-charging techniques for fast battery recharge. Power supply shall be capable of a minimum of 60 hours of standby power with an additional 15 minutes for powering signal devices.
- O. Batteries: Shall be completely maintenance free and shall not require liquids, fluid level checks, refilling, and shall not be capable of producing spills and/or leaks, sealed gel-cell type with expected life of 10 years Battery voltage shall be as required by the FACP and related equipment. Battery shall have sufficient capacity to power the fire alarm system for not less than sixty (60) hours plus 15 minutes of alarm upon a normal AC power failure. Battery cabinet shall be twice the size of the batteries it will contain.
- P. Enclosures: The FACP shall be housed in a UL listed cabinet suitable for surface or semi-flush mounting. Cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators. For convenience, the door may be hinged on either the right or left side (field selectable). Where multiple enclosures are required in the same area the cabinets shall all be the same size and color. Cabinet doors must be electrically bonded to enclosure it serves.
- Q. Provide framed operating instructions under glass at the FACP location.

2.2 ALARM APPLIANCES

A. Voice/Tone Notification Appliances:

1. Appliances shall comply with UL 1480 and shall be listed and labeled by an NRTL.
2. Wattage: Field selectable at $\frac{1}{4}$, $\frac{1}{2}$, 1 or 2 watts.
3. Mounting: Flush or surface mounted and bidirectional.

B. Strobe Lights shall be located as shown on the Drawings. Strobe lights indicated for use exterior to the building shall be mounted at the indicated elevation and listed for use in wet locations. Strobe lights flash in synchronization and shall have the following specifications:

1. Voltage: Strobe lights shall operate on 24 VDC nominal.
2. Maximum pulse duration: 2/10ths of one second.
3. Mounting: Provide surface mounting devices suitable for mounting in a standard single gang device box unless otherwise indicated on the Drawings. Unless otherwise indicated on the Drawings, strobe lights shall be mounted at 96" Above Finished Floor (AFF) to the top of the device.
4. Strobe intensity and flash rate: Must meet minimum requirements of UL 1971. Provide synchronous strobe lights with specific intensity Candela (Cd) rating of 15/75 Cd in all locations unless indicated otherwise on the drawings.

C. Audible/Visual Combination Devices shall be located as shown on the Drawings and shall comply with all applicable requirements for both Voice/Tone appliances and Strobe Lights. Unless otherwise indicated on the Drawings, combination A/V devices shall be mounted at shall be mounted at 96" Above Finished Floor (AFF) to the top of the device.

2.3 INITIATING DEVICES

A. Addressable Devices - General: Unless otherwise indicated on the Drawings all initiating devices shall be individually addressable. All detectors shall be the plug in type with a separate base to facilitate testing and maintenance. Provide locking tabs for all models located within 12' of floor. All devices shall be provided with terminal strips for circuit connections, "Pigtails" are not acceptable. Provide skirts for bases to create a finished appearance.

1. Address Setting: Addressable devices shall provide an address setting means that use rotary decimal switches configured to provide decade (numbered 1 to 10) type addresses. Devices, which use a binary address setting method, such as a dipswitch, are not acceptable. Devices, which are addressed by the FACP, are acceptable.
2. Connections: Addressable devices shall be connected to a Signaling Line Circuit (SLC). Signaling Line Circuits shall originate as indicated on the Riser Diagram shown in the Drawings.
3. Intelligent Initiation Devices: All smoke detectors shall be the "intelligent" in that smoke detector sensitivity shall be set through the FACP and shall be adjustable in the field through the field programming of the system. Sensitivity shall be capable of being automatically adjusted by the FACP on a time-of-day basis. Using software in the FACP,

- detectors shall be capable of automatically compensating for dust accumulation and other slow environmental changes that may affect performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72, Chapter 7.
4. Devices shall be capable of reporting obscuration level to the panel for reporting purposes.
 5. Device Mounting Base: Unless otherwise specified all existing detectors are ceiling-mount and replacement shall be ceiling mounted and shall include a separate twist-lock base with tamper proof feature.
 6. Test Means: The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel when in the "test" condition.
 7. Device Identification: Detectors shall store an internal identifying type code that the control panel shall use to identify the type of device. Device identifications shall be either ION, PHOTO, or THERMAL.
- B. Addressable Pull Stations - General: Addressable pull stations shall, on command from the Control Panel, send data to the panel representing the state of the manual switch. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.
1. All pull stations shall have a positive, visual indication of operation and utilize a key type reset. Allen key type locks are unacceptable. Two (2) keys for each pull station shall be supplied to NC State.
 2. Construction: Pull stations shall be constructed of Lexan or other material suitable to the installation environment with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches or larger. Stations shall be suitable for surface mounting or semi flush mounting as shown on the plans. Unless otherwise indicated on the Drawings pull stations shall be mounted at 48" Above Finished Floor.
- C. Photoelectric Smoke Detectors: Photoelectric smoke detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density. Unless otherwise indicated on the Drawings all smoke detectors shall be photoelectric type.
- D. Thermal Detectors: Thermal Detectors shall be intelligent addressable devices rated at 135°F. (58° C.) and unless otherwise indicated on the Drawings shall have a rate-of-rise element rated at 15° F. (9.4° C.) per minute. It shall connect via two wires to the Fire Alarm Control Panel Signaling Line Circuit. Addressable thermal detectors must not be used in spaces in which the temperature rating of the electronics is exceeded. In such cases, use conventional thermal detectors with an addressable module. Mount module in nearest conditioned space and indicate its address on the outside of the enclosure by means of a label. Up to 99 intelligent heat detectors may connect to one SLC loop.

- E. Duct Smoke Detector: In-Duct Smoke Detector Housings shall accommodate either an intelligent photoelectric sensor as described elsewhere and shall be velocity rated. The device, independent of the type used, shall provide continuous analog monitoring and alarm verification from the panel. When sufficient smoke is sensed, an alarm signal shall be initiated at the FACP.
 - 1. Installation: Duct detectors and related items shall be furnished, connected and installed by the Contractor.

2.4 MISCELLANEOUS SYSTEM ITEMS

- A. Addressable Dry Contact Monitor Module: Addressable Monitor Modules shall be provided to connect one supervised IDC zone (either Style D or Style B) of conventional Alarm Initiating Devices (any Normally Open [N.O.] dry contact device) to one of the Fire Alarm Control Panel Signaling Line Circuit Loops. Monitor modules shall be installed as required by the system configuration. All required monitor modules may not be shown on the Drawings.
 - 1. Indication of Operation: Unless otherwise indicated on the Drawings an LED shall be provided that shall flash under normal conditions, indicating that the Monitor Module is operational and in regular communication with the control panel.
 - 2. Mounting Requirements: Monitor Modules shall be mounted in a standard 4-inch square, 2-1/8" deep electrical box at the same height as Audio Visual devices in a clearly visible location.
- B. Two Wire Detector Monitor Module: Addressable Monitor Modules shall be provided to connect one supervised IDC zone, either Class A or B (Style D or Style B operation) of conventional 2-wire smoke detectors or alarm initiating devices (any N.O. dry contact device) to one of the Fire Alarm Control Panel Signaling Line Circuit Loops. Monitor modules shall be installed as required by the system configuration. All required monitor modules may not be shown on the Drawings.
 - 1. Indication of Operation: Unless otherwise indicated on the Drawings an LED shall be provided that shall flash under normal conditions, indicating that the Monitor Module is operational and in regular communication with the control panel.
 - 2. Mounting Requirements: Monitor Modules shall mount in a standard 4-inch square, 2-1/8" deep electrical box, and shall only be installed in conditioned spaces.
- C. Addressable Control Module: Addressable Control Modules shall be provided to supervise and control the operation of one conventional Notification Appliance Circuit (NAC) of compatible, 24 VDC powered, polarized Audio/Visual (A/V) Notification Appliances. For fan shutdown and other auxiliary control functions, the control module may be set to operate as a dry contract relay. The control module shall provide address-setting means using decimal switches and shall also store an internal identifying code that the control panel shall use to identify the type of device. An LED shall be provided that shall flash under normal conditions, indicating that the control module is operational and is in regular communication with the control panel. Control modules shall be rated for the load they control. (Inductive Loads require inductive rated modules.)

1. Mounting Requirements: Control Modules shall mount in a standard 4-inch square, 2-1/8" deep electrical box, and shall only be installed in conditioned spaces.
 2. Configuration: The control module NAC circuit may be wired for Style Y Class B with up to 1 Amp of inductive A/V signal, or 2 Amps of resistive A/V signal operation, or as a dry contact (Form C) relay. The control module shall be suitable for pilot duty applications and rated for a minimum of 0.6 amps at 30 VDC. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires.
 3. Power Source: Audio/visual power shall be provided by a separate supervised power loop from the main fire alarm control panel or from a supervised, UL listed remote power supply. A/V power sources and connections are not shown on the Drawings
 4. Test Switch: A magnetic test switch shall be provided to test the module without opening or shorting its NAC wiring.
- D. Isolator Module: Isolator Modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC loop. The Isolator Module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC Loop.
1. Operation: Isolator Modules shall operate such that if a wire-to-wire short occurs, the Isolator module shall automatically open-circuit (disconnect) the SLC loop. When the short circuit condition is corrected, the Isolator Module shall automatically reconnect the isolated section. The Isolator Module shall not require any address setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an Isolator Module after its normal operation.
 2. Mounting: The Isolator Module shall mount in standard 4-inch square, 2-1/8" deep electrical boxes at the same height as A/V devices in a clearly viewable area in corridors. It shall provide a single LED that shall flash to indicate that the Isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.
 3. Locations: Provide isolator modules at FACP for both ends of each SLC loop. Provide a minimum of one (1) module in the field at the mid-point of the device loop. Provide additional modules necessary to limit the number of devices between isolators to 20.
- E. Door Hold-Open Magnets: Door hold open magnets shall be suitable for mounting in a single gang electrical device box. Door hold open magnets shall be furnished with keepers, door chains, and other accessories as required to properly hold open doors as indicated on the Drawings. Holding force of the magnet shall be appropriate for the door to be held open. Proper attachment of door magnet hardware to doors is the responsibility of the Division 16 contractor. Door hold open magnets shall operate in a fail-safe manner, *i.e.*, the door shall release in event of a failure of voltage to the device.
1. Power Supply: Door hold open magnets shall be configured to operate from a nominal 24 VDC system as supplied by the FACP or other power supply listed for the purpose. All hold open magnet supply sources, whether a part of the FACP or whether derived from a separate power supply, shall be supervised. Door hold open magnets which use step-down transformers, 120 VAC, or local relays are not acceptable. Magnets shall release on a power failure.

2. Device box support: Door hold open magnet device boxes shall be securely attached to the building structure by effective means. Boxes attached directly to only one metal stud or boxes supported by means of expansion type fasteners are not acceptable.
- F. Remote Power Supplies: Where remote power supplies are required, they shall meet the same requirements as those for the main fire alarm control panel, including the requirements for batteries.
- G. Keys and Locks: All panels, terminal cabinets, and pull stations shall be keyed alike. Coordinate key/lock with the Owner's requirements.

2.5 SYSTEM REQUIREMENTS

- A. Fire and smoke detection and alarm systems shall comply with the following system requirements with regard to operation and installation.
 1. All equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation. Refer to the Riser/Connection diagram for all specific system installation/termination/wiring data.
 2. All system components shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load. Adhesives are not permitted to mount fire alarm system components to building surfaces or structure.
- B. The system shall be new and furnished with a warranty (parts & labor) of a minimum of one year from the date of final acceptance by the Owner. Should the manufacturer provide a standard warranty of greater than one (1) year, that time period shall be the minimum warranty period. Equipment, initiating devices, and alarm appliances shall be arranged as described in the Drawings; annunciator zones shall be configured as described in the Drawings.
- C. The system shall be equipped with the following protective devices to prevent damage or nuisance alarms by nearby lightning strikes, stray currents, or voltage transients. The devices are to be provided by the fire alarm equipment supplier:
 1. On AC Input: A feed-through (not shunt-type) branch circuit transient suppressor such as Leviton 51020-WM-DN, or Di-Tech DTK-120S20A, or equivalent UL 1449 – 4th Edition Listed device. Install suppressor in a listed enclosure near the electrical panelboard, and trim excess lead lengths. Wind small coil in the branch circuit conductor just downstream of the suppressor connection. Coil to be 5 to 10 turns, about 1" diameter, and securely tie-wrapped. This series impedance will improve the effectiveness of the suppressor in clipping fast rise time voltage transients.
 2. On DC Circuits Extending Outside Building: Adjacent to the FACP, and also near point of entry to outlying building, provide "pi"-type filter on each leg, consisting of a primary arrester, series impedance, and a fast acting secondary arrester that clamps at 30v-40v.

Some acceptable models: Simplex 2081-9027, Simplex 2081-9028, Transtector TSP8601, Ditek DTK 2MHLP24B series, Citel America B280-24V, and Northern Technologies DLP-42. Submit data on others to the engineer for approval. UL 497B listing is normally a prerequisite for their consideration. Devices using only MOV active elements are not acceptable.

- D. Both audible and visible alarm signals shall be provided. Visible signals must be the strobe (flash discharge) type, with white or clear lens, and shall comply with current ADA requirements for intensity and placement.
- E. The FACP must have an Alarm Silence switch, and be equipped with the Subsequent Alarm (alarm resound) feature. Any remote annunciators or graphic displays located away from the alarm area must also include an audible signal with alarm resound feature and must be silence-able from the main panel.
- F. A supervised "AHU Shutdown Defeat" switch must be provided in the FACP. The switch must be labeled and its "Normal" position indicated.
- G. The coverage of each fire alarm zone as described in the Drawings shall be indicated on the FACP and any remote annunciator. This may be accomplished by engraved labels, framed directories, and/or graphic displays. Label tape or handwritten labels are not acceptable.
- H. Systems are to be provided with a separate and independent source of emergency power. Switching to emergency power during alarm shall not cause signal drop-out. Batteries must meet the appropriate NFPA capacity requirements, with a 25% safety factor.
- I. All wiring shall be color coded in accordance with the following scheme, which shall be maintained throughout the system, without color change in any wire run:

<u>Addressable Devices</u>	<u>Approved Manufacture Data Cable</u>
Initiating Circuits, General*	Red (+)/White (-)
Signal Line Circuit Cable	Red jacket with Red(+)/Black(-)
Alarm Indicating Appliance Circuits	Blue (+)/Black (-)
AHU Shutdown Circuits	Yellow (+)/Brown (-)
Door Control Circuits	Orange

- J. There shall be NO splices in the system other than at terminal blocks. "Wire nuts," crimp splices, or insulation piercing type connectors are not acceptable. All terminal block screws shall have pressure wire connectors of the self-lifting or box lug type.
- K. Permanent wire markers shall be used to identify all splices and terminations for each circuit. For splices, use markers or other means to indicate which conductors leads to the FACP. All junction boxes and covers shall be painted red, unless in finished areas.

- L. Device Numbering: Device number shall correspond to the way cable is installed (sequentially).
- M. All wiring and cable must be in EMT, 3/4" minimum diameter, unless indicated otherwise on the Drawings or elsewhere in the Specifications.
 - 1. The exterior of all junction boxes containing fire alarm conductors shall be painted red; box interiors shall not be painted. Box covers for junction boxes containing fire alarm conductors shall be painted red on both sides. All painting of junction boxes and junction box covers shall be accomplished prior to installation of the boxes to avoid possible problems with overspray.
 - 2. Box covers shall be labeled to indicate the circuit(s) or function of the conductors contained therein. Labels shall be neatly applied black lettering on a clear background. Handwritten labels or labels made from embossed tape are not acceptable.
- N. Wire shall be new AWG #14 minimum stranded copper, type THHN/THWN for notification appliance circuits. Addressable loop (signaling line) circuits shall be wired with type FPL/FPLR/FPLP fire alarm cable, AWG 18 minimum, low capacitance, twisted shielded copper pair. Cable shield drain wires are to be connected at each device on the loop to maintain continuity, taped to insulate from ground, and terminated at the FACU. Acceptable cables include Atlas 228-18-1-1STP, BSCC S1802s19 (same as EEC 7806LC), West Penn D975, D991 (AWG 16), D995 (AWG 14), or equal wire having capacitance of 30pf/ft. maximum between conductors. Belden 5320FJ acceptable if only FPL rating needed. The cable jacket color shall be red, with red (+) and black (-) conductor insulation.
 - 1. EXCEPTION #1: Unshielded cable, otherwise equal to the above, is permitted to be used where the manufacturer's installation instructions unequivocally require, or state a preference for, the use of unshielded cable of all systems, AWG #16 minimum.
 - 2. EXCEPTION #2: In underground conduit, use Type TC or PLTC cable (PE insulated) to avoid problems from moisture.
- O. Detection or alarm circuits must not be included in raceways containing AC power or AC control wiring. Within the FACP, any 120 VAC control wiring or other circuits with an externally supplied AC/DC voltage above the nominal 24 VDC system power must be properly separated from other circuits and the enclosure must have an appropriate warning label to alert service personnel to the potential hazard.
- P. Provide an engraved label in FACP identifying its 120 VAC power source. This label shall include panel board location, identification, and circuit number. Any circuit breaker supplying 120v to any Fire Alarm equipment must have a locking tab installed at the breaker.
- Q. All wiring shall be checked for grounds, opens, and shorts, prior to termination at panels and installation of detector heads. The minimum resistance to ground or between any two conductors shall be ten megohms (10 MW), as verified with a megger. Provide advance notice to the A/E of these tests.
- R. All connections at the FACP must be made by the Manufacturer's authorized, factory trained representative (rather than by the electrical contractor).

- S. The system shall be electrically supervised for open or (+/-) ground fault conditions in SLC, alarm circuits, and control circuits. Removal of any detection device, alarm appliance, plug-in relay, system module, or standby battery connection shall also result in a trouble signal. Fire alarm signal shall override trouble signals, but any pre-alarm trouble signal shall reappear when the panel is reset.
- T. All addressable devices shall be installed in "conditioned" spaces.
- U. Spare Parts: Provide the following spare parts with the system, each individually packaged and labeled. For multi-building projects, calculate separately for each building:

Fuses- two (2) of each size used in the installed system.

MPS- w/ monitor modules – Minimum one (1) or 2% of total installation.

Audio-visual devices – Minimum one (1) or 4% of total installation.

Indoor strobe only devices – Minimum one (1) or 4 % of total installation.

Exterior indicating devices – Minimum one (1) or 2% of total installation.

Spot Smoke Detectors – Minimum one (1) or 6% of total installation.

Spot heat/thermal detectors – Minimum one (1) or 6% of total installation.

Spot detector bases – Minimum one (1) or 2% of total installation.

Spot detector sounder bases – Minimum one (1) or 6% of total installation.

Relay modules – Minimum one (1) or 4% of each total installation.

Monitor modules – Minimum one (1) or 4% of total installation.

Isolation modules – Minimum one (1) or 4% of total installation.

- 1. Increase decimal quantities of spare parts to the next higher whole number. For example if a system has 20 spot-type smoke detectors provide 2 spare detectors with bases.

2.6 ALARM VERIFICATION FOR SMOKE DETECTORS

- A. The fire alarm system shall be equipped with logic method of verifying the presence of smoke.
 - 1. Alarms from other than spot type smoke detectors must not be delayed by Alarm Verification. Alarm Verification is NOT to be applied to linear beam or duct smoke detectors, nor to any software configured "cross-zoned" detection devices. 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.
- B. Systems with Alarm Verification must be permanently labeled to indicate that fact.

- C. While a verification cycle is in progress, an alarm, which occurs on another zone, must not cause the verification cycle under way to be restarted or extended. It may have the same effect on the system as a verified alarm.
- D. The equipment must be Listed for Alarm Verification purposes. It must either be installed at the factory, or field wired and tested by the Manufacturer's authorized representative.

2.7 REMOTE ALARM TRANSMISSION REQUIREMENTS

- A. The fire alarm system (DACT) shall communicate separate signals for Fire Alarm (zone 3), Fire Alarm Trouble (zone 4), Sprinkler Alarm and Sprinkler water flow alarm (zone 5), and Sprinkler Supervisory Trouble (zone 6). All other zones/signals required for specific installations shall be coordinated and approved by the NCSU before installation and programming.
- B. Digital communications shall be via 10 channel dialer complete with battery back-up. Approved dialer in a Fire-Lite MS-10UD.
- C. The DACT shall be mounted in an adjacent or nearest mechanical or electrical room to the FACP unless approved by the owner for installation adjacent to the FACP. Installation in a telecommunications equipment room is prohibited.
- D. The Contractor shall install conduit from a location next to the DACT for connection of the dialer to the main telecommunications room. A minimum 4x4x2.5 inch deep hinged enclosure shall be installed within one (1) foot of the DACT and connected by a one (1) inch conduit. Cable termination will be performed by NC State.
- E. The precedence of alarm system transmission shall be as follows:
 - 1. Fire
 - 2. Supervisory
 - 3. Trouble
 - a. The "trouble" signal for AC power loss must not be sent unless maintained for 6 hours or more to avoid nuisance transmissions due to momentary 120 VAC power outages or alarm verification cycles.

2.8 SMOKE DETECTORS

- A. Detectors: Must be the plug-in type, each having a separate base, to facilitate replacement and maintenance. 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.
- B. Spot type smoke detectors mounted within 12 feet of a walking surface shall have their built-in locking device activated.

- C. Unless suitably protected against dust, paint, etc., detectors shall not be installed until the final construction clean-up has been completed. Contaminated detectors must be REPLACED by the Contractor at no additional cost to the Owner.
- D. Duct detector sampling tubes shall extend the full width of the duct. Those over 36 inches long must be provided with rear support. The preferred method for doing this is to have the tube go through the far side of the duct, with the point of penetration tightly sealed to prevent air leakage around the tube. This facilitates smoke testing and tube cleaning. Duct smoke detector mounting position and air sampling tube orientation, are critical for proper operation. The Manufacturer's detailed installation instructions must be followed. The contractor shall mark the direction of airflow on the duct at each duct detector location. Provide duct access doors.
- E. Identification of individual detectors is required. These device numbers, which must also be shown on the shop drawings, shall be permanently affixed to the detector base. Device labels may not be affixed to the device. Identification labels must be printed labels with black lettering on a clear background. Handwritten labels or labels made from embossed tape are not acceptable.

2.9 AUTOMATIC SMOKE DOOR REQUIREMENTS

- A. Wall-mounted magnetic door holders and separate heavy-duty closers shall be used, instead of combination door control units. The electromagnets shall be controlled by the building's smoke detection system FACP. Individual smoke detector auxiliary contacts shall not be used to release door holders.

PART 3 - EXECUTION

3.1 GENERAL

- A. The Designer shall conduct a mandatory "pre-construction meeting" with the electrical contractor, the fire alarm contractor and the NCSU construction management team . The purpose of this meeting is to insure NCSU understands the contractor's installation plan and the contractor understands NCSU's site specific requirements. No work may begin until this meeting occurs.
- B. In addition to other requirements of these Specifications the fire alarm system must comply with the following:
 - 1. The addressable fire alarm system shall be connected, programmed, and tested only by the Manufacturer or by an authorized distributor who stocks a full compliment of spare parts for the system. Technicians performing this service shall be trained and individually certified by the Manufacturer for the model of system being installed. Copies of installer certification must be included with the Contractor's submittal.
 - 2. The complete configuration data (site-specific programming) for the system must be permanently stored on a computer disk or diskette and archived by the manufacturer or

- authorized distributor. A diskette copy of this data must be submitted to the A/E for transmission to the Owner when the system is commissioned.
3. The Manufacturer or authorized distributor must maintain software version (VER) records on the system installed. The system software shall be upgraded free of charge if a new VER is released for any reason during the warranty period. For any new VER to correct problems, free upgrade shall apply during the entire life of the system.
 4. All addressable loop controller circuits must be "Class A", with no "T" taps and shall have a minimum of 20% spare addresses for future use. To minimize the impact of a wiring fault on the system, isolation modules must be provided as follows:
 - a. After each 20 devices/control points on any addressable circuit.
 - b. For each circuit extending outside the building.
 - c. In the FACP, at each end of the loop.
 - d. On loops containing less than the 20 devices place an isolator at each end of the loop and one in the electrical center of the loop.
 5. Supervision required: The connection between individual addressable modules and their contact type initiating device(s) must be supervised.
 6. The Fire Alarm System shall have multiple access levels, which permit the Owner's authorized personnel to make temporary changes in the system alarm response matrix without actually changing the system programming. This must include the ability to override selected alarm inputs or system responses to alarms without affecting the remaining portions of the system.
- C. Floor Plans with Device Numbers: A copy of the floor plans shall be provided in the control panel. A separate sheet shall be provided for each floor. All device addresses shall be clearly labeled on plans. Indicate locations of all cabinets, modules and end of line resistors. Plans shall be bound bound and installed in a "tube" adjacent to the FACP. Provide legend for symbols.

3.2 SYSTEM TESTING & 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 must have occurred within the most recent 24 months, except that a NICET Level III certification will extend this to 36 months. Copies of the certifications must be part of the Shop Drawing submittal to the engineer, prior to installation. The submittal cannot be approved without this info.

The technician who makes final connections and programs the FACP is legally the "installer" even though most field connections to system devices and appliances are normally made by electrical contractor personnel. The responsibility for assuring a proper installation overall rests with this individual. In addition to doing the final hookups and activating the system, this individual is expected to check enough field connections to assure a proper job was done there. The absence of system "trouble" signals is not a sufficient measure of the field wiring,

which could have "T" taps, the wrong type of wire, improper terminations, ground (drain wire) issues, etc.

- B. When programming the system, activate the automatic drift compensation feature for all spot-type smoke detectors. Systems with alarm verification are not to have this feature activated without written direction from the owner's representative or the AHJ. Alarm verification must not be used with multi-sensor/multi-criteria detectors under any circumstances, as inadequate system response may result.
- 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 must include the program settings for each alarm initiating device and the current sensitivity of each analog addressable smoke detector.
- E. The manufacturer or authorized distributor (by definition, "installer") must 100% test all site-specific software functions for the system and then provide a detailed report or check list showing the system's operational matrix. This documentation must be part of the "System Status and Programming Report".
- F. Upon completion of the installation and its programming, the installer's technician shall test every alarm initiating device for proper response and indication, and all alarm notification appliances for effectiveness. Also, in coordination with the other building system contractors, all other system functions shall be verified, including (where applicable) elevator capture and the control of HVAC systems, door locks, pressurization fans, fire or smoke doors/dampers/shutters, etc.
- G. The installer must fill out and submit the following documentation to the owner, through the engineer, prior to the system acceptance inspection:
 - 1. The NFPA 72-2013, Figure 1-6.2.1, "Record of Completion" Form. 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. The fire alarm installer (manufacturer or authorized distributor's technician) must sign this form.
 - 2. The System Status and Programming Report. This must be generated on the day of the system acceptance inspection.
- H. After completion of the 100% system test and submission of documentation, the installer is to request the engineer to set up an inspection. The system must operate for at least two days prior to this inspection. 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. This inspection is intended to assure that the contractor has properly installed the system and performed the 100% operational test as required by NFPA 72. This will be a 100% test. The electrical contractor shall provide two-way radios, ladders, and any other materials needed for testing the system, including a suitable smoke source. The engineer must witness a "clean" 100% test before the system is accepted.

- I. A full copy of all final shop drawings, battery calculations, etc. shall be provided at the FINAL inspection for review by Designer, Owner and NCSCO.

3.3 LABELLING

- A. When field addressable modules are located in junction boxes, the junction box covers must be labeled as to their contents (e.g. 3-24 Sprinkler Monitor).
- B. Contractor shall label all wires terminating in junction boxes and riser boxes. These labels shall be self-sticking wire numbers or similar type. Write-on labels are prohibited. Contractor shall provide a typed legend for all junction boxes and riser boxes corresponding to these labels. Legend shall be mounted in riser boxes (if applicable). If system does not have riser boxes, contractor shall provide legend to NCSU Electronic Systems at time of University acceptance of system installation.
- C. All initiating devices and modules shall be labeled with their respective addresses; including loop and point number.
- D. All device labels shall be made using an electronic labeling system with black letters on white background. Write-on labels are prohibited.

3.4 SYSTEM DOCUMENTATION, TRAINING, AND MAINTENANCE

- A. In addition to the Shop Drawing submittal, the fire alarm system contractor shall provide the engineer copies of the following technical information, for transmittal to the owner
 1. Three (3) copies of maintenance, repair manuals and two (2) copies of software manuals required in operation, maintenance, repair, and modification (for system additions or deletions) of fire alarm system.
 2. Documentation provided shall be complete and include all necessary information to support the above stated functions. Manuals shall be bound, and published, consisting of the following:
 - a. Installation Manual
 - b. Operator/Users Manual
 - c. Technical Manual
 - d. Programming Manual
 3. Documentation must be provided to the University at the time of acceptance.
- B. Warranty and Preventive Maintenance Requirements
 1. System shall have a 12 month warranty period for all installed or delivered hardware and software. During the 12 month warranty period, one annual preventive maintenance (PM) inspection/test shall be performed on the entire fire alarm system by the contractor. This PM is to be performed 6 months or more after University acceptance of system. The system acceptance test, punch list items, and other acceptance issues do not meet the PM inspection/test requirement. All system

deficiencies found shall be documented and corrected during this PM. All parts and repairs shall be covered under the system warranty. This PM shall include all items to be annually tested as defined by tables 7-2.2 and 7-3.2 in NFPA 72, latest edition, in addition to the following:

- a. Complete software backup (where applicable).
 - b. Performance test of battery backup.
2. All tests shall be scheduled by the Contractor through Facilities Operations Electronic Systems and will required fifteen (15) days notice. The test shall be witnessed by a representative designated by NCSU Facilities Operations Electronic Systems.
 3. A report consisting of the NFPA Inspection and Testing Form shall be furnished by the contractor, to the Engineer of Record and NCSU Construction Management within 2 days after completion of this test. The NFPA Inspection and Testing Form can be found on page 72-111, of NFPA 72, latest edition.

C. Training Requirements

1. The Contractor shall provide to the University sixteen (16) hours of on site owners training. Training to include hardware repair and maintenance by University personnel of all building panels, devices, including but not limited to diagnostic procedures, system expansion and maintenance techniques.

Contractor shall also provide to the University factory sponsored certified technical training for system installed. This training shall certify two (2) technicians to maintain, service, and program installed system and receive direct manufacturer's technical support for these systems, to include software updates if applicable. All expenses, to include tuition, transportation by University approved vendor and lodging for this training, shall be the responsibility of the contractor.

D. Programming and Software Requirements

1. Contractor shall also include all software, hardware, interfaces, adapters, and cables, etc. required for all programming, and maintenance functions.
2. If the contractor would normally use a laptop to program the system, a similar computer shall be supplied even if programming from the FACP keypad is available.
3. Contractor shall provide to the University, all software required for full system maintenance and upgrades to fire alarm system including any device changes, additions, or deletions.
4. Contractor shall provide to the University, without cost, all software updates during the warranty period and free upgrades to software following the warranty period that address system operating failures or known defects during the life of the system.
5. Contractor shall provide to the University all levels of password access, and documentation to support the use of the above mentioned.

- E. 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" (see 7.7) must either be kept at/in the FACP, or its location shall be permanently indicated there by engraved label.

- F. Provide an engraved label inside the FACP and any NAC panels identifying its 120vac power source, as follows: Panelboard location, panelboard identification, and branch circuit number.

END OF SECTION 283111

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