

BID SET PROJECT MANUAL

DETENTION ANNEX RENOVATION WAKE COUNTY, NORTH CAROLINA

**WAKE COUNTY RFB # 25-112
ARCHITECT'S PROJECT NO.: 642088**



ARCHITECT/ENGINEER

CHARLOTTE, NORTH CAROLINA

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CARY, NORTH CAROLINA

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CHARLOTTE, NORTH CAROLINA

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RALEIGH, NORTH CAROLINA

PALACIO COLLABORATIVE

COST CONSULTANT

GREENVILLE, SOUTH CAROLINA

October 13, 2025

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ADVERTISEMENT

Sealed proposals will be received by Wake County Procurement Services, in Suite 2900, Wake County Justice Center, 301 McDowell Street, Raleigh, NC 27601, for providing labor, material and equipment entering into the construction of the Wake County Detention Annex Renovation (Wake County RFB # 25-112), located in Raleigh, NC.

Sealed bids will be received until 3 PM on November 19, 2025. All bids will be publicly opened and read starting immediately thereafter.

The general scope is as follows:

Renovations to existing Wake County detention annex building; originally constructed in 1988. An addition was added in 2001, and the facility has been closed since 2013. The facility shall be renovated and updated to comply with North Carolina Jail Standards, including space layouts, architectural finishes, detention furniture and components, upgrading of utilities, and site work. The Work also includes construction of a new open-air shelter to provide a cover for Owner-provided storage containers.

A Mandatory Pre-Bid Conference will be held at 2 PM local prevailing time on November 5, 2025 at the Wake County Detention Center Annex, located at 3400 Hammond Road. All prime bidder Contractors are to be present. All Contractors shall note that there is currently construction activity at the site for a separate contract. All Contractors shall bring appropriate construction site PPE (hard hat, gloves, eye protection, sturdy closed toe shoes, and high visibility vest/clothing at minimum) and shall be required to wear PPE during the pre-bid walkthrough.

An electronic copy of the contract documents (PDF) may be obtained from Moseley by sending an email request to Betty Godwin at bgodwin@moseleydesigns.com.

Wake County provides minorities and women equal opportunity to participate in all aspects of its construction program consistent with NCGS §143-8. Bidders shall comply with the requirements of the Wake County Minority Business Enterprise Program, as outlined in the Wake County Minority and Women Business Enterprise Resolutions for Construction Contracts included in this Project Manual.

No bid may be withdrawn for sixty (60) days after the scheduled closing time for bids.

Wake County reserves the right to reject any or all bids and to waive informalities.

Signed: COUNTY OF WAKE

By: Sarah Kahr Richter, PE
Project Manager
Wake County Government
Facilities Design & Construction

DESIGNER:

Moseley
6210 Ardrey Kell Road
The Hub at Waverly, Suite 425
Charlotte, NC 28277
704-540-3755

INSTRUCTIONS TO BIDDERS

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

1. PROPOSALS

Proposals must be made on the Bid Proposal Forms provided herein, and all blank spaces for Bids, Alternates and Unit Prices, applicable to bidder's work, shall be properly filled in. When requested Alternates are not Bid, the Proposal may be considered non responsive. The Bidders agree that Bids submitted on the specified Bid Proposal Forms, which are detached from specifications, will be considered and will have the same force and effect as if attached thereto. Numbers shall be stated both in writing and in figures for the Base Bids and Alternates.

Any modification to the Bid Proposal Forms (including Alternates and/or Unit Prices) may disqualify the Bid and may cause the Bid to be rejected.

The Contractor shall fill in the Bid Proposal Forms as follows:

- A. If the documents are executed by a sole Owner, that fact shall be evidenced by the word "Owner" appearing after the name of the person.
- B. If the documents are executed by a Partnership, that fact shall be evidenced by the word "Co-Partner" appearing after the name of the partner executing them.
- C. If the documents are executed on the part of a Corporation, they shall be executed by either the President or the Vice-President and attested by the Secretary or Assistant Secretary. In either case the title of the office of such person shall appear after their signatures. The seal of the Corporation shall be impressed on each signature page of the documents.
- D. If the Proposal is made by a Joint Venture, it shall be executed by each member of the Joint Venture in the above form for sole Owner, Partnership, or Corporation, whichever form is applicable.
- E. All signatures shall be properly witnessed or attested as applicable.
- F. Each proposal shall be addressed as indicated in the Advertisement for Bids and shall be delivered, enclosed in an opaque sealed envelope, marked "Proposal" and bearing the name of Project, name and address of the Bidder, the Bidder's license number and, if applicable, the designated portion of the Work for which Bid is submitted.
- G. It shall be the specific responsibility of the Bidder to deliver the Bid to the proper official at the appointed place and prior to the announced time for the opening of Bids. Later delivery of a Bid for any reason, including delivery by the United States Mail, shall disqualify the Bid.

- H. Modifications of previously deposited Bids or requests for withdrawal will be acceptable only if delivered in person or in writing to the place of the Bid opening prior to the time for opening Bids.
- I. Unit Prices quoted in the Proposal shall include overhead and profit and shall be the full compensation for the Contractor's cost involved in the work.
- J. All Bidders shall submit, attached to the bid, evidence of compliance with the Owners Minority Business Enterprise Program as outlined in the Wake County Minority and Women Business Enterprise Resolutions for Construction Contracts included in this Project Manual.

2. REQUIREMENTS FOR DOCUMENTING MINORITY BUSINESS PARTICIPATION

- A. Documentation to be submitted with each bid proposal
 - 1. All Bidders must provide, with the bid, Wake County Form MBE –1 (2002), Identity of Minority Business Participation, which identifies the minority businesses that will be used on the project, with the total dollar value of the work that will be performed by the listed minority businesses. Wake County Form MBE –1 (2002), Identity of Minority Business Participation, is a part of the bid form.
 - 2. All Bidders must provide, with the bid, one of the following:
 - a. Wake County Form MBE –2 (2002) – a listing of the good faith efforts made to solicit minority participation in the bid effort. A bidder must earn a minimum of 50 points from the good faith efforts listed for their bid to be considered responsive or;
 - b. Wake County Form MBE –3 (2002) – This form is to be submitted only by bidders certifying that all the work on the project will be performed 100% by their own workforce.

All bidders must submit with their bid on the applicable forms; failure to submit the required forms may be grounds for rejection of the bid.

- B. Documentation to be submitted by the apparent low bidder after notification by the Owner

After the bid opening the Owner will consider all bid proposals and then determine and contact the apparent lowest responsible, responsive bidder. Within 72 hours of receipt of notification of being the apparent lowest responsible, responsive Bidder the Bidder shall submit the following:

 - 1. If the Bidder's minority business participation meets or exceeds the established goal of 10%, the Bidder must submit Wake County Form MBE–4 (2002). This form is to include a description of the portion of work to be executed by minority business, expressed as a percentage of the total contract price.

2. If the Bidder's minority business participation is less than the established goal of 10%, the Bidder must submit Wake County Form MBE – 5 (2002). This form is to document the Bidder's good faith efforts to meet the established goal. Documentation to be provided on this form shall be evidence of all good faith efforts made, including any advertisements, solicitations and other specific actions demonstrating recruitment and selection of minority business for participation in the contract.

C. Other documentation to be provided after contract award

1. Within 30 days after a contract is awarded, or sooner if required by the Contract Documents, the successful Bidder must provide, to the Owner, a list of all subcontractors to be used on the project. The list must identify the minority category of each minority subcontractor.
2. With the final request for payment the successful Bidder shall provide a complete listing of all minority businesses used on the project, along with the total dollar value of work performed by each minority business. This information must be provided on Wake County Form MBE- 6 (2002).

3. EXAMINATION OF CONDITIONS

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

Reference is made to the Contract Documents for the identification of those surveys and investigative reports of subsurface or latent physical conditions at the site or otherwise affecting performance of the work which have been relied upon by the Licensed Professional who prepared the documents. Copies of all such surveys and reports are available to the Bidders, upon request. All Bidders are responsible for reviewing these documents prior to submission of their Bid Proposal.

Each Bidder may, at his own expense, make such additional surveys and investigations, as he may deem necessary to determine his Bid price for the performance of the work. Any on-site investigation shall be done at the convenience of the Owner. The Owner will honor any reasonable request for access to the site.

4. SUBSTITUTIONS

Material substitutions will be considered during the bidding phase until seven (7) days prior to the receipt of bids. No substitutions will be considered after seven (7) days prior to the receipt of Bids.

For proposed material substitutions submit the following information to the Licensed Professional who prepared the bidding documents:

- Name of manufacturer
- Address of manufacturer
- Phone number of manufacturer
- Trade name
- Model or catalogue designation
- Manufacturer's data including:
 - Performance and test data
 - Reference standards
- Detailed comparison with specified product including:
 - Performance
 - Test results
 - Warranties
 - Gauge, thickness or strength or material
 - Finish
 - Other pertinent data
- Other information requested by the Licensed Professional who prepared the bidding documents

Submittals relating to substitutions, which are not fully complete by seven (7) days prior to the receipt of bids, will not be reviewed.

If the Licensed Professional who prepared the bidding documents accepts a material substitution, Contractors will be notified by Addendum.

5. ADDENDA

Any Addenda to bidding documents issued during the time of bidding will be sent to each Bidder, and are to be considered covered in the Bid Proposal. It is the Contractor's responsibility to ascertain prior to Bid time, which Addenda have been issued and confirm that his Bid Proposal includes any changes covered by the Addenda.

Should the Bidder find discrepancies in, or omissions from, the drawings or documents or should he be in doubt as to their meaning, he shall at once notify the Licensed Professional who prepared said drawings or documents. Neither the Owner nor the Licensed Professional who prepared the bidding documents will be responsible for any oral instructions.

The Bidder on his Bid Proposal shall acknowledge all Addenda. Failure to do so may disqualify the Bid and may cause the Bid to be rejected.

6. BID SECURITY

Each Proposal shall be accompanied by a cash deposit, or a certified check drawn on some bank or trust company insured by the Federal Deposit Insurance Corporation, or a Bid Bond in an amount equal to not less than five percent (5%) of the Proposal. Said deposit to be retained by the Owner (referred to as Obligee on the Bond Form) as liquidated damages in event of failure of the successful Bidder to execute the Contract within ten (10) days after the award or to give satisfactory Surety as required by law.

The Bid Bond shall be conditioned that the surety will, upon demand, forthwith make payment to the Owner (referred to as Obligee on the Bond Form) upon the said bond if the Bidder fails to execute the contract.

A Wake County Bid Bond form is included in the project manual. The language in the Bid Bond form is required. Your Bid may be considered non-responsive if your Surety uses a different Bid Bond form. Notify your Surety that the language in the Wake County Bid Bond form must be used.

7. RECEIPT OF BIDS

Bids and Bid Security shall be received in strict accordance with requirements of the North Carolina General Statutes. Prior to opening of any Bids on the Project, the Bidder will be permitted to change or withdraw his Bid as allowed by Item 1-H of these Instructions.

All copies of the Bid, the Bid security, if any, and any other documents required to be submitted with the Bid shall be enclosed in a sealed opaque envelope. The envelope shall be addressed to the party receiving the Bids and should be identified with the Project name, time and date of Bid Opening, the Bidder's name and address, Bidder's license number and, if applicable, the designated portion of the Work for which the Bid is submitted. If the Bid is sent by mail, the sealed envelope shall be enclosed in a separate mailing envelope with the notation "SEALED BID ENCLOSED" on the face thereof.

8. OPENING OF BIDS

Upon opening, all Bids shall be read aloud. Once any Bid is opened, the Owner may return no Bids to any Bidder.

After Bids are opened, a Bidder may request that his Bid be withdrawn without forfeiting his Bid deposit in certain limited circumstances. Withdrawal after opening is permitted only if all of the following conditions specified in North Carolina General Statutes §143-129.1 are met:

- A. The Bid was submitted in good faith.
- B. The price Bid "was based upon a mistake, which constituted a substantial error".
- C. Credible evidence is submitted showing that the error (1) was clerical in nature, as opposed to a judgment error; and (2) was actually due to an unintentional and substantial arithmetic error or an unintentional omission of a substantial quantity of work, labor, material or services made directly in the compilation of the Bid.

- D. The error can be clearly shown by objective evidence drawn from inspection of the original work papers, documents, or materials used in the preparation of the Bid.
- E. The request to withdraw (1) is made in writing to the public agency that invited the Proposals, and (2) is made prior to the award of the Contract, but not later than seventy-two (72) hours after the opening of Bids.

9. REJECTION OF BIDS

The Owner reserves the unqualified right to reject any and all Bids. Reasons for rejection may include, but shall not be limited to, the following:

- A. If the Form of Proposal furnished to the Bidder is not used or is altered.
- B. If the Bidder fails to insert a price for all Bid items, Alternates and Unit Prices requested.
- C. If the Bidder adds any provisions reserving the right to accept or reject any award.
- D. If there are unauthorized additions or conditional Bids, or irregularities of any kind which tend to make the Proposal incomplete, indefinite, or ambiguous as to its meaning.
- E. If the Bidder fails to complete the Proposal forms where information is requested so the Bid may be properly evaluated by the Owner.
- F. If the Unit Prices contained in the Bid Schedule are unacceptable to the Owner.
- G. If the Bidder fails to comply with other instructions stated herein.
- H. If the Bidder fails to provide all documentation confirming compliance with the Wake County Minority Business Enterprise Program.

10. BID EVALUATION

The award of the Contract will be made to the lowest responsible Bidder as soon as practical. Should the successful Bidder default and fail to execute a Contract, the Contract may be awarded to the next lowest and responsible Bidder.

Before awarding a Contract, the Owner may require the apparent low Bidder to qualify himself to be a responsible Bidder by furnishing any or all of the following data:

- A. The latest financial statement showing assets and liabilities of the company or other information satisfactory to the Owner.
- B. A listing of similar completed projects of similar size, with contact persons and telephone numbers.
- C. Permanent name and address of place of business.

- D. The number of regular employees of the organization and length of time the organization has been in business under present name and percentage of work typically performed by the contractor's firm.
- (1) Qualifications of key employees assigned to this Project.
- (2) References for key employees assigned to this Project.
- E. The name and home office address of the Surety proposed and the name and address of the responsible local claim agent.
- F. The names of members of the firm who hold appropriate trade licenses, together with license numbers.
- G. Complete list of all subcontractors and suppliers proposed.
- H. Any pending arbitration or mediation cases or lawsuits. This may include all arbitration, mediation and lawsuits settled or resolved within last ten (10) years.

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

In determining the lowest responsible Bidder, the Owner may consider the past performance of the Bidder on construction contracts for the County of Wake, Wake County Public School System, the State of North Carolina or other governmental agencies. Particular concern will be given to completion times, quality of work, cooperation with other Contractors, and cooperation with the Designer and Owner.

Should the Owner adjudge that the apparent low Bidder is not the lowest "responsible" Bidder by virtue of the above information, said apparent low Bidder will be so notified and his Bid Security shall be returned to him.

The Owner shall have the right to accept Alternates in any order or combination and to determine the low Bidder on the basis of the sum of the Base Bid and the Alternates accepted.

The Owner reserves the right to reject any and all Bids, to waive all technicalities and irregularities, and to make the award as considered to be in the best interest of the Owner.

11. PERFORMANCE BOND

The successful Bidder, upon award of Contract, shall furnish a Performance Bond in an amount equal to one hundred percent (100%) of the Contract price.

12. PAYMENT BOND

The successful Bidder, upon award of Contract, shall furnish a Payment Bond in an amount equal to one hundred percent (100%) of the Contract price.

13. PRE-BID CONFERENCE

Bidders are requested to attend a Pre-Bid Conference at the time and place stipulated in the Bidding Documents.

15. INFORMATION TO BIDDER

All questions concerning the plans and specifications should be directed to the Licensed Professional who prepared said documents.



Facilities Design & Construction

☎ 919 856 6350
📠 919 856 6355

Waverly F. Akins Wake County Office Building
P.O. Box 550 • Raleigh, NC 27602
336 Fayetteville St., Room 1100 • Raleigh, NC 27601
wake.gov

Notice of Wake County Electronic Contracting Processes for Construction Agreements

All Wake County contracts are now executed and processed electronically. The successful lowest responsive responsible bidder upon award of the construction contract must be a registered Wake County vendor to start the electronic contract process. Any company not registered as a Wake County vendor must register. The County will contact the low bidder and offer instructions on how to register as a vendor or update their existing vendor registration info if needed.

Upon notification of contract award, contractor will be issued instructions for processing Performance and Payment Bonds, Certificates of Insurance, and issuance of the Construction Agreement

Contracts will then be transmitted via DocuSign for signing, attesting, and execution.

WAKE COUNTY DETENTION ANNEX RENOVATION

Project No. RFB # 25-112

BID PROPOSAL FORM

(USE THIS FORM ONLY. Bids submitted on anything other than the form(s) provided may be considered non-responsive and subject to rejection)

**SINGLE PRIME GENERAL CONSTRUCTION WORK
FORMAL CONTRACT**

BIDDERS NAME

_____ License Number: _____

BASE BID PROPOSAL

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 informed himself fully in regard to all conditions pertaining to the place where the work is to be done; that he has examined the specifications for the work and the Contract Documents relative thereto, including addenda, if any, 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 proposes and agrees if this Proposal is accepted to contract with the County of Wake with a definite understanding that no money will be allowed for extra work except as set forth in the General Conditions and Contract Documents, for the sum of:

Base Bid _____

_____ Dollars (\$_____).

Line Item: Provide a line-item amount for all work associated with the morgue container shelter, including architectural, utility, and site work. This amount is for the Owner's information only and shall be included in the Base Bid amount above. This amount shall have no bearing on determining low bidder.

Morgue Shelter Line Item (Figures Only): \$ _____

SUBCONTRACTOR LISTING

PLUMBING CONTRACTOR

Name: _____ License Number: _____

\$ _____

HVAC CONTRACTOR

Name: _____ License Number: _____

\$ _____

ELECTRICAL CONTRACTOR

Name: _____ License Number: _____

\$ _____

(OTHER CONTRACTOR)

Name: _____ License Number: _____

\$ _____

(OTHER CONTRACTOR)

Name: _____ License Number: _____

\$ _____

(OTHER CONTRACTOR)

Name: _____ License Number: _____

\$ _____

(OTHER CONTRACTOR)

Name: _____ License Number: _____

\$ _____

ALTERNATES

Should any of the alternates as described in the specifications be accepted, the amount written below shall be the amount to "add to" or "deduct from" the Base Bid. If to be "deducted from" Base Bid, put minus sign (-) in parentheses at head of alternate and plus sign (+) in parentheses if to be "added to". For Owner-Preferred Brands, the alternate amount shall be the *difference* between the Owner-Preferred Brand and the Base-Bid brand proposed by bidding Contractor. If the brand proposed by bidding Contractor is also the Owner-Preferred Brand, place "0" in the alternate amount. Refer to Division 1 Section "Alternates" for more detailed description of each alternate.

Alternate No. 1: Sealed Concrete in lieu of Polished Concrete	Dollars () \$ _____
Alternate No. 2: Electronic Plumbing Control – Owner-Preferred Brand	Dollars () \$ _____
Alternate No. 3: Site Lighting	Dollars () \$ _____
Alternate No. 4: Security Locks – Owner-Preferred Brand	Dollars () \$ _____
Alternate No. 5: Sprinkler Heads – Owner-Preferred Brand	Dollars () \$ _____
Alternate No. 6: Re-Roofing of Sectors B & C	Dollars () \$ _____
Alternate No. 7: Fire Alarm – Owner-Preferred Brand	Dollars () \$ _____
Alternate No. 8: Building Automation System – Owner-Preferred Brand	Dollars () \$ _____

LUMP SUM ALLOWANCES

Lump sum allowances shall include the stipulated sum for each item indicated below. These allowance amounts shall be included in the Base Bid total. Refer to Division 1 Section "Allowances" for additional information on each allowance and for additional requirements.

Lump Sum Allowance No. 1: Provide the stipulated sum of \$1,400,000 for security electronics.

Lump Sum Allowance No. 2: Provide the stipulated sum of \$340,000 for data systems.

Lump Sum Allowance No. 3: Provide the stipulated sum of \$150,000 for cleaning of the existing building.

Lump Sum Allowance No. 4: Provide the stipulated sum of \$10,000 for building signage.

Lump Sum Allowance No. 5: Provide the stipulated sum of \$150,000 for Owner's contingency.

UNIT PRICE ALLOWANCES

Unit prices are complete for labor, equipment, material, overhead and profit. Base bid total shall include the stipulated allowance quantity of each item. Unused amounts will be credited to the Owner by change order at the end of the project. Refer to Division 1 Sections “Allowances” and “Unit Prices” for additional information pertaining to each unit price allowance.

BASE BID Unit Price Allowances – Include in Base Bid price

Description	Unit Price	Unit Measure	Allowance Units
1. Soil removal and replacement with crushed stone		Per CuYd	20 Cu Yd
2. Off site disposal of waste soil or rock		Per CuYd	20 Cu Yd
3. Moisture Vapor Treatment		Per SqFt	2,000 Sq Ft
4. Removal and Replacement of Deteriorated Wall Construction At Fire Walls/Partitions		Per SqFt	200 Sq Ft

ALTERNATE Unit Price Allowances – Include in Alternate No. 6 price

Description	Unit Price	Unit Measure	Allowance Units
5. Replacement of Insulated Roof Pavers		Per SqFt	2,000 Sq Ft
6. Prep and Application of Rust Inhibitor for Steel Components		Per SqFt	300 Sq Ft
7. Removal and Replacement of Modified Bitumen roofing membrane		Per SqFt	500 Sq Ft
8. Removal and Replacement of Gypsum Coverboard		Per SqFt	500 Sq Ft
9. Removal and Replacement of Polyiso Roof Insulation		Per SqFt	500 Sq Ft

Provide with the bid - Under GS 143-128.2(c) the bidder shall identify and include **with the bid**, **Wake County Form MBE-1 Identity of Minority Business Participation**, 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. **All bidders must submit, with the bid, Wake County Form MBE-1 Identity of Minority Business Participation Form even if there is zero MBE participation.**

Also include with the bid a list of the good faith efforts made to solicit minority participation in the bid effort, **Wake County Form MBE-2 Listing of the Good Faith Effort**.

NOTE: A contractor that performs all of the work with its own workforce may submit **Wake County Form MBE-3-Intent to Perform Contract with Own Workforce**, to that effect in lieu of **Wake County Form MBE-2-Listing of the Good Faith Effort**.

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 lowest responsible, responsive bidder, the bidder must then file within 72 hours of the notification **Wake County Form MBE-4**. It includes that portion of the Work to be Performed by Minority Business. Also included is 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 **Wake County Form MBE-5** is not necessary,

OR

If less than the 10% goal, **Wake County Form MBE-5** documenting all good faith efforts 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 project.

Note: Bidders must always submit **with their bid** the Identification of Minority Business Participation Form listing all MBE contractors, vendors, and suppliers that will be used. If there is no MBE participation, then enter none or zero on the form. **Wake County Form MBE-2** or **Wake County Form MBE-3** as applicable must also be submitted with the bid. Failure to submit a required affidavit or form with the bid or within the time required may be grounds for rejection of the bid.

Attach to Bid Form

WAKE COUNTY FORM MBE-1 (2002)

IDENTIFICATION OF MINORITY BUSINESS PARTICIPATION FORM

I _____
(Name of Bidder)

do hereby certify that on this project we will use the following minority business enterprises as construction subcontractors, vendors, suppliers or providers of professional services.

[illegible]

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

The total value of minority business contractors will be \$_____.

Attach to Bid Form

Wake County – Form MBE-2 (2002)

Listing of the Good Faith Effort

Affidavit of _____
(Name of Bidder)

I have made a good faith effort to comply under the following areas checked:

Bidders must earn at least 50 points from the good faith efforts listed for their bid to be considered responsive. (1 NC Administrative Code 30 I.0101)

- ☐ ☐ **1 – (10 pts)** Contacted minority businesses that reasonably could have been expected to submit a quote and that were known to the contractor, or available on State or local government maintained lists, at least 10 days before the bid date and notified them of the nature and scope of the work to be performed.
- ☐ ☐ **2. -(10 pts)** Made the construction plans, specifications and requirements available for review by prospective minority businesses, or providing these documents to them at least 10 days before the bids are due.
- ☐ ☐ **3 - (15 pts)** Broken down or combined elements of work into economically feasible units to facilitate minority participation.
- ☐ ☐ **4 - (10 pts)** Worked with minority trade, community, or contractor organizations identified by the Office of Historically Underutilized Businesses and included in the bid documents that provide assistance in recruitment of minority businesses.
- ☐ ☐ **5 - (10 pts)** Attended prebid meetings scheduled by the public owner.
- ☐ ☐ **6 - (20 pts)** Provided assistance in getting required bonding or insurance or provided alternatives to bonding or insurance for subcontractors.
- ☐ ☐ **7 - (15 pts)** Negotiated in good faith with interested minority businesses and did not reject them as unqualified without sound reasons based on their capabilities. Any rejection of a minority business based on lack of qualification should have the reasons documented in writing.
- ☐ ☐ **8 - (25 pts)** Provided assistance to an otherwise qualified minority business in need of equipment, loan capital, lines of credit, or joint pay agreements to secure loans, supplies, or letters of credit, including waiving credit that is ordinarily required. Assisted minority businesses in obtaining the same unit pricing with the bidder's suppliers in order to help minority businesses in establishing credit.
- ☐ ☐ **9 - (20 pts)** Negotiated joint venture and partnership arrangements with minority businesses in order to increase opportunities for minority business participation on a public construction or repair project when possible.
- ☐ ☐ **10 - (20 pts)** Provided quick pay agreements and policies to enable minority contractors and suppliers to meet cash flow demands.

The undersigned, if apparent low bidder, will enter into a formal agreement with the firms listed in the Identification of Minority Business Participation schedule conditional upon scope of contract to be executed with the Owner. Substitution of contractors must be in accordance with GS 143-128.2(d). Failure to abide by this statutory provision will constitute a breach of the contract.

The undersigned hereby certifies that he or she has read the terms of the minority business commitment and is authorized to bind the bidder to the commitment herein set forth.

Date: _____

Name of Authorized Officer _____

Signature _____

Title: _____



State of North Carolina, County of _____

Subscribed and sworn to before me this __ day of _____ 20__

Notary Public _____

My commission expires _____

Attach to Bid Only If Bidder Performs All Work With Own Workforces

Wake County Form MBE-3 (2002)
Intent to Perform Contract with Own Workforce

Affidavit of

(Name of Bidder)

I hereby certify that it is our intent to perform 100% of the work required for the project

(Name of Project)

In making this certification, the Bidder states that the Bidder does not customarily subcontract elements of this type project, and normally performs and has the capability to perform and will perform all elements of the work on this project with his/her own current work forces; and

The Bidder agrees to provide any additional information or documentation requested by the owner in support of the above statement.

The undersigned hereby certifies that he or she has read this certification and is authorized to bind the Bidder to the commitments herein contained.

Date: _____

Name of Authorized Officer: _____

Signature: _____

Title: _____



State of North Carolina, County of _____

Subscribed and sworn to before me this __ day of _____ 20__

Notary Public _____

My commission expires _____

CERTIFICATION OF PROPOSER:

The Bidder further proposes and agrees hereby to commence work under his Contract on a date to be specified in a written order of Wake County and shall fully complete all work thereunder within the number of consecutive calendar days stipulated in the Supplementary General Conditions. Applicable liquidated damages shall be as stated in Supplementary General Conditions.

The undersigned acknowledges receipt of the following addenda issued during the time of bidding and includes the changes therein in this Proposal:

Addendum Number _____, Dated _____

Addendum Number _____, Dated _____

Addendum Number _____, Dated _____

The undersigned agrees that this Proposal will not be withdrawn for a period of sixty (60) days.

The undersigned agrees to comply with the E-Verify requirements of the General Statutes of North Carolina, all contractors, including any subcontractors employed by the contractor(s), by submitting a bid, proposal or any other response, or by providing any material, equipment, supplies, services, etc., attest and affirm that they are aware and in full compliance with Article 2 of Chapter 64, (NCGS64-26(a)) relating to the E-Verify requirements.

The undersigned agrees not to discriminate in any manner on the basis of race, natural hair or hairstyles, ethnicity, creed, color, sex, pregnancy, marital or familial status, sexual orientation, gender identity or expression, national origin or ancestry, marital or familial status, pregnancy, National Guard or veteran status, religious belief or non-belief, age, or disability with reference to the subject matter of this Contract. The Parties agree to comply with the provisions and intent of Wake County Ordinance SL 2017-4. This anti-discrimination provision shall be binding on the successors and assigns of the Parties with reference to the subject matter of this Contract.

The undersigned further agrees that in the case of failure on his part to execute the said Contract and the Bond within ten (10) consecutive calendar days after written notice being given of the award of the Contract, the check, cash or Bid Bond accompanying this Bid shall be paid into the funds of Owner's Account set aside for this Project, as liquidated damages for such failure; otherwise the check, cash or Bid Bond accompanying this Proposal shall be returned to the undersigned.

Respectfully submitted this ___ day of _____, 20__

PROPOSER SIGNATURE PAGE

(Name of Firm or Corporation making Bid)

By: _____

WITNESS:

(Proprietorship or Partnership)



Affix Corporate Seal Above

Title: _____
(Owner, Partner, or Corporation President
or Vice President only)

Address: _____

License Number: _____

ATTEST:

By: _____

Title: _____
(Corporation Secretary or Assistant Secretary only)

BID BOND

KNOW ALL MEN BY THESE PRESENTS, that we, _____,
(Bidder's Name)

_____, of _____
(Street Address) (City, State, Zip)

hereinafter called the Principal, and _____ of
(Surety's Name)

_____, a Corporation duly organized, and existing under the laws of the State of
_____ and authorized to transact business in the State of North Carolina, as Surety,
hereinafter called the Surety, are held and firmly bound unto the County of Wake as Owner, hereinafter called the Obligee, in
the Penal sum of five percent (5%) of the amount bid, good and lawful money of the United States of America, for the payment
for which the Principal and the Surety, bind ourselves, their heirs, executors, administrators, successors and assigns, jointly and
severally, firmly by these presents. This bid bond is submitted in lieu of submitting cash, a cashier's check, or a certified check
pursuant to G.S. 143- 129.

WHEREAS, the Principal has submitted a Bid for the construction of _____.
(Project Name)

NOW THEREFORE, if the Obligee shall accept the Bid of the Principal and the Principal shall enter into a Contract with the
Obligee in accordance with the terms of said Bid, and give such bond or bonds as may be specified in the Bidding and Contract
Documents with good and sufficient surety for the faithful performance of such Contract and for the prompt payment of labor
and materials furnished in the prosecution thereof, then this obligation shall be null and void; but if the Principal fails to so
execute such Contract and give such bonds as required by G.S. 143-129, this obligation shall otherwise remain in full force and
effect and the Surety shall, upon demand, forthwith pay to the Obligee the full amount set forth in the first paragraph hereof.

SIGNED AND SEALED this __ day of _____, 20__ in the presence of:

Witness _____

Witness _____

Principal (SEAL)

Surety (SEAL)

Title

Title

******USE OF BOND FORM OTHER THAN THIS MAY RESULT IN DISQUALIFICATION OF THE BIDDER******

**PART 1 WAKE COUNTY MINORITY AND WOMEN BUSINESS ENTERPRISE
RESOLUTIONS FOR CONSTRUCTION CONTRACTS**

**1.1 R-02-52 RESOLUTION UPDATING WAKE COUNTY PROCEDURES AND
POLICIES RELATING TO COUNTY CONSTRUCTION
PROJECTS AWARDED PURSUANT TO N.C.G.S. §143-128 ET
SEQ.**

WHEREAS, the North Carolina General Assembly has recently amended Article 8 of N.C.G.S. Chapter 143, Public Contracts, to increase the threshold for public contracts which must be bid, and to make other changes related to construction methods, construction management and minority business participation, and

WHEREAS, Wake County has adopted resolutions directing the County Manager to prepare and maintain minority and women business enterprise programs for all construction projects funded by Wake County (R-88-20) and establishing a verifiable percentage goal for minority business in awarding construction contracts the costs of which exceed one hundred thousand dollars (\$100,000) (R-90-13), and

WHEREAS, recent amendments to N.C.G.S. §143-129(a) have increased the threshold amount of public construction contract which must be bid from one hundred thousand dollars (\$100,000) to three hundred thousand dollars (\$300,000), and

WHEREAS, N.C.G.S. §143-128(a1) has increased the permissible methods that public bodies may use in awarding construction contracts, and

WHEREAS, N.C.G.S. §143-128.2 now requires more extensive efforts and detailed record keeping related to minority business participation in construction projects,

NOW, THEREFORE, BE IT RESOLVED by the Wake County Board of Commissioners

Section 1. That Resolutions R-90-13 and R-88-20 be amended to provide that the County Manager be directed to establish policies and procedures for bidding and awarding County building projects which comport with the requirements of Article 8 of N.C.G.S. Chapter 143, Public Contracts, as it is from time to time amended, and which are consistent with the policies contained in those Resolutions.

**1.2 R-90-13 RESOLUTION TO ESTABLISH A VERIFIABLE PERCENTAGE
GOAL FOR PARTICIPATION BY MINORITY BUSINESS IN THE
AWARDING OF BUILDING CONSTRUCTION CONTRACTS
AWARDED PURSUANT TO N.C.G.S. §143-128**

WHEREAS, N.C.G.S. §43-128(c) requires each county to adopt, after notice and a public hearing, an appropriate verifiable percentage goal for participation by minority businesses (as defined in that statute) in the total value of work for building contracts the costs of which exceed one hundred thousand dollars (\$100,000) and which are awarded pursuant to N.C.G.S. §143-128; and

WHEREAS, N.C.G.S. §143-128(c)(3) requires a county awarding a building contract the cost of which exceeds one hundred thousand dollars (\$100,000) under a separate prime or separate specification contract system to adopt written guidelines specifying actions that will be taken by the county to ensure a good faith effort in the recruitment and selection of minority businesses for building contracts awarded under the separate prime or separate specification contract system; and

WHEREAS, N.C.G.S. §143-128(c)(4) requires a county awarding a building contract the costs of which exceeds one hundred thousand dollars (\$100,000) under a single-prime contract system to adopt written guidelines specifying the action that the prime contractor must take to ensure a good faith effort in the recruitment and selection of minority businesses for building contracts awarded under the single prime contract system; and requires that action taken by the prime contractor must be documented in writing by the contractor to the County; and

WHEREAS, N.C.G.S. §143-128(b) requires that a county choosing to use a single-prime contract system must also seek bids for a building contract the cost of which exceeds one hundred thousand dollars (\$100,000) under a separate prime or separate specification contract system and must award such building contract to the lowest responsible bidder or bidders for the total project; and

WHEREAS, N.C.G.S. §143-128(d) requires the county to award public building contracts the costs of which exceed one hundred thousand dollars (\$100,000) without regard to race, religion, color, creed, national origin, sex, age or handicapping condition; and

WHEREAS, notice of the public hearing was duly published and the public hearing required by N.C.G.S. §143-128(c) was held February 19, 1990;

NOW THEREFORE, BE IT RESOLVED BY the Wake County Board of Commissioners

Section 1. That Wake County shall have a verifiable goal of ten percent (10%) for participation by minority businesses in building construction contracts awarded pursuant to N.C.G.S. §143-128.

Section 2. That for each such building contract put out for bids under the separate specification or the single prime contract systems, notice of the contract shall be transmitted to the Minority Business Development Agency in Raleigh, North Carolina and the North Carolina Institute of Minority Economic Development in Durham, North Carolina (hereinafter "minority agencies").

Section 3. That for each such building contract put out for bids under the separate specification or single prime contract systems, documents related to the contract shall be available for inspection at a convenient and accessible location of which minority agencies shall receive notice.

Section 4. That for any such building contract put out for bids under the separate specification contract system, the County shall maintain records with respect to:

- a. those contractors or subcontractors that bid or otherwise respond to notice of the project,
- b. those contractors or subcontractors awarded contracts as part of the project, and
- c. the percentage of work on the project that is to be performed by minority businesses.

Section 5. That for any such building contract put out for bids under the single prime contract system, the single prime contractor shall:

- a. notify appropriate minority businesses of the portion of the project which will be subcontracted by the single contractor and solicit bids from those minority agencies.
- b. submit with his bids records with respect to:
 1. those minority subcontractors notified of the project and of those elements of the project for which subcontracts will be let, and
 2. those minority subcontractors that bid or otherwise respond to notice of the project, and
 3. those minority subcontractors awarded contracts as part of the project, and
 4. the percentage of work on the project that is to be performed by minority businesses.

Section 6. That these policies shall be a part of the request for proposals for any such contract, and noncompliance by any single prime bidder shall be grounds for declaring the bid non-responsive.

Section 7. The County Manager is hereby authorized to impose additional requirements, not inconsistent with the requirements of this resolution and pursuant to the resolution of this Board enacted February 28, 1988, the purposes of which are to promote the goal and intent of this resolution.

Commissioner Heater moved the adoption of the foregoing resolution. Commissioner Ward seconded the motion and, upon vote, the motion passed unanimously this the 19th day of February, 1990.

**1.3 R-88-20 WAKE COUNTY, NORTH CAROLINA MINORITY AND WOMEN
BUSINESS ENTERPRISE RESOLUTION FOR CONSTRUCTION
CONTRACTS**

WHEREAS, the Board of County Commissioners of Wake County, North Carolina desires that all segments of the population of Wake County have equal opportunity to compete for contracting and subcontracting work offered by the County; and

WHEREAS, it is in the best interest of Wake County to develop and maintain as large a pool of qualified, prospective contractors to draw upon as possible;

WHEREAS, it is the judgment of the Wake County Board of Commissioners that the County has a compelling interest to implement a minority/women business enterprise program to ensure the representative participation of all segments of the population in the County's economy; and

NOW, THEREFORE, BE IT RESOLVED that the Board of County Commissioners of Wake County declares that it is their policy to provide minorities and women equal opportunity to participate in all aspects of the County's construction program consistent with Chapter 143, Article 8 of the General Statutes of the State of North Carolina.

BE IT FURTHER RESOLVED that the Board of Commissioners of Wake County hereby directs the County Manager to prepare and maintain a minority and women business enterprise program for all construction projects funded by the County.

Upon motion of Commissioner Stout, seconded by Commissioner Zieverink, and upon roll call vote, the Board adopted the above resolution this 29th day of February 1988

PART 2 MINORITY BUSINESS ENTERPRISE PARTICIPATION IN WAKE COUNTY BUILDING CONSTRUCTION AND REPAIR CONTRACTS

2.1 POLICY STATEMENT

It is the policy of the County to encourage minorities to participate in its building construction, renovation and repair projects.

It is further the policy of the County to prohibit illegal discrimination against any person or business enterprise and to conduct its building construction, renovation and repair programs so as to prevent such discrimination.

It is the policy of the County in concert with other local, state and federal agencies and with the assistance of minority groups and agencies, to seek and identify qualified minority business enterprises (MBEs) and to offer them the opportunity to participate, and to encourage them to participate, in the County's building construction and repair programs. Under this policy, the County adopts the definition of MBEs contained in N.C.G.S. § 143-128.2.

It is the policy of the County to provide information and opportunities to minority business enterprises that are available to other business enterprises, and to establish procedures providing MBEs access to information and opportunities available to other business enterprises.

It is the intent of this policy to secure contractors' participation and ensure competition. Nothing in this policy shall be construed to require contractors or the County to award contracts or subcontracts 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.

The County will award public building construction and repair contracts to the lowest responsible, responsive bidder as provided by Article 8 of Chapter 143 of the North Carolina General Statutes.

2.2 SCOPE: This Policy Applies To Minority Business, Minority Persons, and Socially and Economically Disadvantaged Individuals [Ref: N.C.G.S. §143-128.2(g)]

A. A Minority Business (MBE) is a business:

1. In which at least fifty-one percent (51%) is owned by one or more minority persons or socially and economically disadvantaged individuals, 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

2. 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.
- B. A Minority Person¹ is a person who is a citizen or lawful permanent resident of the United States, and who is:
1. Black, that is, a person having origins in any of the black racial groups in Africa;
 2. 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;
 3. 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;
 4. American Indian or Alaskan Native, that is, a person having origins in any of the original peoples of North America; or
 5. Female.
- C. A Socially and Economically Disadvantaged Individual is defined by 15 U.S.C. 637 as a socially disadvantaged individual 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. In determining the degree of diminished credit and capital opportunities, the federal government considers factors such as assets and net worth. This category includes members of economically disadvantaged Indian tribes.

2.3 VERIFIABLE GOALS FOR MINORITY BUSINESS ENTERPRISE PARTICIPATION²

- A. County Funded Building Construction or Repair Projects costing \$5000 or more.
1. The County has established a verifiable goal of ten percent (10%) for participation by minority businesses in building construction and repair projects covered by this section. [Ref: N.C.G.S. §143-128.2 (a)]
- B. For Building Construction or Repair Projects Using State Appropriations or Other State Grant Funds Where the Project Cost is Equal to or Greater than One

¹ For building projects funded in whole or in part with federal funds, Hasidic Jews are also considered minority persons.

² Projects funded in whole or in part with federal funds will comply with applicable federal thresholds regarding Minority and Woman Owned Business Enterprises participation.

Hundred Thousand Dollars (\$100,000), the County shall use the State's verifiable goal of ten percent (10%) for participation by minority business in building construction and repair projects covered by this section. [Ref: N.C.G.S. §143-128.2 (a)]

PART 3 REGULATIONS AND PROCEDURES FOR IMPLEMENTING MINORITY BUSINESS ENTERPRISE PARTICIPATION POLICY

3.1 INFORMAL BUILDING PROJECTS: Building construction and repair projects costing more than Five Thousand Dollars (\$5,000), but less than Three Hundred Thousand Dollars (\$300,000).

A. County Responsibilities:

1. Notify Minority Business Enterprises of bidding opportunities by one of the following methods:
 - a) Advertise the project at the Raleigh/Durham/Triad Minority Business Development Center or similar institution, or;
 - b) Advertise the project in an identified Minority Business Enterprise targeted newspaper(s) or;
 - c) Attempt to contact Minority Business Enterprises totaling at least 30% of the total number of vendors contacted [Ref.: N.C.G.S. §143-129. (b)]
2. Record all contractors contacted, along with the list of contractors provided with bidding documents.
3. Identify Minority Business firms contacted and record their minority category.
4. Record all contractors submitting bids, along with the amount of each bid.
5. Within five (5) days of project completion, submit a completed "Informal Construction Project Report Form" to the Wake County Finance Department.
6. The Wake County Finance Department will collect store, and report data and forms referenced in this Section 00600. See Section 3.3

B. Contractor Responsibilities:

1. The Contractor will provide the following documentation, Wake County Form MBE-6, at contract closeout and prior to final payment by the county.
 - a) A list of minority business's used on the project, identifying the businesses name, type of work performed, and minority category.
 - b) List the dollar amount paid to each minority business and the percentage it represents of the final project value.

3.2 FORMAL BUILDING PROJECTS: Building construction and repair projects costing Three Hundred Thousand Dollars (\$300,000) or more.

A. County Responsibilities:

1. Advertise Building Projects. When soliciting bids for formal building construction and repair projects, the county must
 - a) Advertise or post notice of bid opportunities to MBE and other potential bidders in trade publications (or whatever it is that we use now) and MBE targeted publications, plans review rooms or newspaper(s) with general circulation at least fourteen (14) days prior to the scheduled bid opening date. [Ref: N.C.G.S. §143-128.2(e)(3)]
 - b) Include the following in each advertisement or notice published: (i) a description of the work for which the bid is being solicited; (ii) the date, time, and location where bids are to be submitted; (iii) the name of the individual within the public entity who will be available to answer questions about the project; (iv) where bid documents may be reviewed; (v) notice of the date, time, and location of the prebid conference. [Ref: N.C.G.S. §143-128.2(e)(3)]
2. Hold a prebid conference prior to bid opening for each project and assure a County representative is in attendance. [Ref: N.C.G.S. §143-128.2(e)(2)]
3. Allow contractors to obtain, at least 10 days before the bid date, a complete set of Bidding Documents by providing a refundable deposit as outlined in the project Advertisement or published notice. Deposits will be refunded as stipulated in the Bidding Documents. [Ref: N.C.G.S. §43-128.2(e)(2)]

4. Include in the bidding documents for each project the following forms and a statement that all contractors submitting bids must include all applicable forms, fully completed, and that failure to file required forms with bids may be grounds for rejection of the bid. [Ref: N.C.G.S. §143-128.2.(c)(1)b.]
 - a) Wake County Form MBE-1, identifying minority business participation;
 - b) Wake County Form MBE-2, affidavit listing contractor's good faith efforts to meet the 10% goal for MBE participation, including any advertisements, solicitations, and evidence of other specific actions to recruit minority businesses for participation in the project;
 - c) Wake County Form MBE-3, affidavit evidencing contractor's intent to perform all contract work with its own workforce; and
 - d) A copy of the County's MBE policy and procedures.
5. Maintain all public records created for each project, including all records and documentation relating to MBE procedures, for a period of three years from the date of project completion. See Section 3.3. [Ref: N.C.G.S. §143-128.2(i)]
6. In any building or repair project financed in whole or in part with federal funds, the County must include a statement that all federal guidelines associated with the source of the federal funds must be complied with. For example, projects funded by HUD must comply with all requirements of 24 CFR §135.

B. Contractor Responsibilities:

1. All bidders on formal building construction or repair projects shall undertake a good faith effort to recruit minority businesses and provide documentation of meeting the minimum requirements of N.C. Gen. Stat. § 143-128.2.
 - a) Failure to comply with these procedural requirements and requirements for submittal of information in the Request for Proposals may render the bid non-responsive and may result in rejection of the bid. [Ref: N.C.G.S. §143-128.2.(c)(1)]
 - b) All contractors, including first-tier subcontractors on construction manager at risk projects, that do not propose to do all of the contract work with their own workforce must advertise for

minority subcontractor, vendors and suppliers at least ten days prior to submission of the contractor's bid. [Ref: N.C.G.S. §143-128.2.(f)(1)]

2. Each bidder, including first-tier subcontractors for construction manager at risk projects, must submit a completed Wake County Form MBE-1 and Wake County Form MBE-2. A contractor, including a first-tier subcontractor on a construction manager at risk project, that performs all of the work under a contract with its own workforce may submit a Wake County Form MBE-3 in lieu of Wake County Form MBE-2 otherwise required under this subsection. [Ref: N.C.G.S. §143-128.2.(c)]
3. The apparent lowest responsible, responsive bidder, must submit the following documents within 72 hours after notification of being the low bidder:
 - a) Form Wake County Form MBE-4, an affidavit 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 10% of the total cost of the contract; or
 - b) Form Wake County Form MBE-5, documentation of good faith effort to recruit MBE participation in the project, including any advertisements, solicitations, and evidence of other specific actions demonstrating recruitment of minority businesses for participation in the project. [Ref: N.C.G.S. §143-128.2.(c)(1)]
4. Within 30 days after the award of the contract, or sooner if stipulated in the Bidding Documents, the contractor shall provide to the County with a list of all subcontractors that the contractor will use on the project. [Ref: N.C.G.S. §143-128.2.(c)(2)]
5. During the construction of a project, if it becomes necessary to replace an MBE subcontractor, the prime contractor shall advise the Owner in writing. No MBE subcontractor may be replaced with a different subcontractor except for the following:
 - a) If the subcontractor's bid is later determined by the contractor or construction manager at risk to be nonresponsive or nonresponsive, or the listed subcontractor refuses to enter into a contract for the complete performance of the bid work; or
 - b) With the approval of the County for good cause. [Ref: N.C.G.S. §143-128.2.(d)]

Prior to substituting a subcontractor, the contractor shall identify the substitute subcontractor and inform the County, in writing, of its good faith efforts to replace with another MBE Subcontractor. Good faith efforts as set forth in N.C.G.S. § 143-131(b) apply to the selection of a substitute subcontractor. [Ref: N.C.G.S. §143-128.2(d)]

6. Prior to the final payment being due to the contractor Wake County Form MBE 6, which provides certification of actual work performed by Minority Businesses, must be submitted

3.3 COUNTY RECORD KEEPING PROCEDURES FOR MONITORING CONTRACTOR COMPLIANCE ON COUNTY BUILDING CONSTRUCTION AND REPAIR PROJECTS.

- A. FORMAL CONTRACTS. The County shall maintain for three years from project completion date all records with respect to:

1. Those contractors notified or solicited for each building construction or repair projects, noting all that are minority businesses and their minority category.
2. Those contractors that bid or otherwise responded to advertisements or notices of building construction or repair projects, noting all that are minority businesses and their minority category.
3. Prime contracts awarded, the amount of the contracts, identity of those that are minority business.
4. The subcontractors utilized on projects, identity of minority subcontractors, type work performed by minority subcontractors amount paid minority businesses as reported by the prime contractor(s) awarded the bid.
5. The percentage of work on the project performed by minority businesses as reported by the prime contractor. [Ref: N.C.G.S. §143-128.2(i)]

- B. INFORMAL CONTRACTS: Documents required to be kept by the County under this section will be maintained in the County Finance Department.

1. The requirements for record keeping for Informal Contracts are the same as for Formal Contracts listed above.

3.4 COMPLAINT PROCEDURES.

A. Formal and Informal Contracts:

1. Alleged violations of the provisions of this MBE plan by any party should be reported in writing to the County Manager or his/her designee.
2. The County Manager or his/her designee shall review all facts available and respond in writing. Unresolved complaints may be presented to the Board of County Commissioners. The decision rendered by the Board will be final.

Wake County Form MBE-1 (2002)

I, _____ (Bidder)

[illegible]

The total value of minority business contracting will be (\$)_____.

Attach to Bid

Wake County – Form MBE-2 (2002)

Listing of the Good Faith Effort

Affidavit of _____
(Name of Bidder)

I have made a good faith effort to comply under the following areas checked:

**Bidders must earn at least 50 points from the good faith efforts listed for their bid to be considered responsive.
(1 NC Administrative Code 30 I.0101)**

- ☐ **1 – (10 pts)** Contacted minority businesses that reasonably could have been expected to submit a quote and that were known to the contractor, or available on State or local government maintained lists, at least 10 days before the bid date and notified them of the nature and scope of the work to be performed.
- ☐ **2. -(10 pts)** Made the construction plans, specifications and requirements available for review by prospective minority businesses, or providing these documents to them at least 10 days before the bids are due.
- ☐ **3 - (15 pts)** Broken down or combined elements of work into economically feasible units to facilitate minority participation.
- ☐ **4 - (10 pts)** Worked with minority trade, community, or contractor organizations identified by the Office of Historically Underutilized Businesses and included in the bid documents that provide assistance in recruitment of minority businesses.
- ☐ **5 - (10 pts)** Attended prebid meetings scheduled by the public owner.
- ☐ **6 - (20 pts)** Provided assistance in getting required bonding or insurance or provided alternatives to bonding or insurance for subcontractors.
- ☐ **7 - (15 pts)** Negotiated in good faith with interested minority businesses and did not reject them as unqualified without sound reasons based on their capabilities. Any rejection of a minority business based on lack of qualification should have the reasons documented in writing.
- ☐ **8 - (25 pts)** Provided assistance to an otherwise qualified minority business in need of equipment, loan capital, lines of credit, or joint pay agreements to secure loans, supplies, or letters of credit, including waiving credit that is ordinarily required. Assisted minority businesses in obtaining the same unit pricing with the bidder's suppliers in order to help minority businesses in establishing credit.
- ☐ **9 - (20 pts)** Negotiated joint venture and partnership arrangements with minority businesses in order to increase opportunities for minority business participation on a public construction or repair project when possible.
- ☐ **10 - (20 pts)** Provided quick pay agreements and policies to enable minority contractors and suppliers to meet cash flow demands.

The undersigned, if apparent low bidder, will enter into a formal agreement with the firms listed in the Identification of Minority Business Participation schedule conditional upon scope of contract to be executed with the Owner. Substitution of contractors must be in accordance with GS 143-128.2(d). Failure to abide by this statutory provision will constitute a breach of the contract.

The undersigned hereby certifies that he or she has read the terms of the minority business commitment and is authorized to bind the bidder to the commitment herein set forth.

Date: _____ Name of Authorized Officer: _____

Signature: _____

Title: _____



State of North Carolina, County of _____

Subscribed and sworn to before me this _____ day of _____ 20__

Notary Public _____

My commission expires _____

{Note: Attach to Bid Only if Bidder Performs All Work With Own Workforces }

Wake County Form MBE-3 (2002)

Intent to Perform Contract with Own Workforce

Affidavit of _____
(Name of Bidder)

I hereby certify that it is our intent to perform 100% of the work required for the project

(Name of Project)

In making this certification, the Bidder states that the Bidder does not customarily subcontract elements of this type project, and normally performs and has the capability to perform and will perform all elements of the work on this project with his/her own current work forces; and

The Bidder agrees to provide any additional information or documentation requested by the owner in support of the above statement.

The undersigned hereby certifies that he or she has read this certification and is authorized to bind the Bidder to the commitments herein contained.

Date: _____ Name of Authorized Officer: _____

Signature: _____

Title: _____



State of North Carolina, County of _____

Subscribed and sworn to before me this ____ day of _____ 20__

Notary Public _____

My commission expires _____

Wake County Form MBE-4 (2002)

Portion of the Work to be Performed by Minority Firms

**** (NOTE: THIS FORM IS NOT TO BE SUBMITTED WITH THE BID PROPOSAL) ****

If the portion of the work to be executed by minority businesses as defined in GS143-128.2(g) is equal to or greater than 10% of the bidders total contract price, then the bidder must complete this affidavit. This affidavit shall be provided, to the Owner, by the apparent lowest responsible, responsive bidder within 72 hours after notification of being the apparent low bidder.

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

(Project Name)

Project ID# _____ Amount of Bid \$ _____

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

Attach additional sheets if required

Name and Phone Number	*Minority Category	Work description	Dollar Value

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

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

The undersigned hereby certifies that he or she has read the terms of this commitment and is authorized to bind the bidder to the commitment herein set forth.

Date: _____ Name of Authorized Officer: _____

Signature: _____

Title: _____



State of North Carolina, County of _____

Subscribed and sworn to before me this _____ day of _____ 2003

Notary Public _____

My commission expires _____

Wake County Form MBE-5 (2002)

Good Faith Efforts

**** (NOTE: THIS FORM IS NOT TO BE SUBMITTED WITH THE BID PROPOSAL) ****

If the goal of 10% participation by minority business is not achieved, this affidavit shall be provided, to the Owner apparent lowest responsible, responsive bidder within 72 hours after notification of being the apparent low bidder.

Affidavit of: _____
(Bidder)

I do certify the attached documentation as true and accurate representation of my good faith efforts.

(Attach additional sheets if required)

Name and Phone Number	*Minority Category	Work Description	Dollar Value

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

Documentation of the Bidder's good faith efforts to meet the goals set forth in these provisions. Examples of documentation include, but are not limited to, the following evidence:

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

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

Date: _____ Name of Authorized Officer: _____



Signature: _____

Title: _____

State of North Carolina, County of _____

Subscribed and sworn to before me this _____ day of _____ 20____

Notary Public _____

My commission expires _____

Wake County Form MBE-6 (2002)

CERTIFICATION of Actual Work Performed by Minority Businesses

NOTE: THIS FORM IS TO BE SUBMITTED PRIOR TO FINAL PAYMENT BEING DUE THE CONTRACTOR

Affidavit of _____
(Contractor Name)

(Project Name)

Project ID# _____ Final Contract Amount \$ _____

I do hereby certify that _____% of the total dollar amount of the contract was performed with minority business. Such work was subcontracted to the firms listed below.

Attach additional sheets if required

Name and Phone Number	*Minority Category	Work description	Dollar Value

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

Must list all businesses used, including Prime Contractor, and note which are minority and category

The undersigned hereby certifies that above information is correct to the best of his/her knowledge, information and belief.

Date: _____ Name of Authorized Officer: _____

Signature: _____

Title: _____



State of North Carolina, County of _____

Subscribed and sworn to before me this _____ day of _____ 2002

Notary Public _____

My commission expires _____

CONSTRUCTION AGREEMENT

FOR

THIS AGREEMENT, made as of the ____ day of _____, 20__, by and between _____, a corporation, hereinafter called the Contractor, and Wake County, a body corporate and politic and a political subdivision of the State of North Carolina, hereinafter called the Owner.

WITNESSETH:

That the Contractor and the Owner, for the consideration herein named, agree as follows:

1. SCOPE OF WORK - The Contractor shall furnish and deliver all of the materials, and perform all of the work required by this Agreement and the following enumerated documents, which are attached hereto and made a part hereof as if fully contained herein: General Conditions, Supplemental Conditions, Contract Construction Schedule, Specifications, Drawings entitled " _____ " which Drawings are listed in the Specifications, Performance Bond, Labor and Material Payment Bond, Insurance Certificates, and the following addenda:

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

All of the documents listed, referenced or described in this paragraph, together with Modifications made or issued in accordance herewith are the Contract Documents, and the work, labor, materials and completed construction required by the Contract Documents and all parts thereof is the Work. The Contractor shall perform the Work in the time, manner and form required by the Contract Documents. The Contract Documents constitute the entire agreement between Owner and Contractor.

2. The Contractor agrees to commence work not later than three (3) days after the commencement date specified in the Notice to Proceed. The Contractor agrees to complete fully all Work hereunder on the dates specified in the Contract Documents, as may be adjusted in accordance with the terms thereof. Time is of the essence with respect to all dates specified in the Contract Documents as Completion Dates. Liquidated damages for failure(s) to complete in

accordance with the provisions of this paragraph shall be computed and assessed against the Contractor in accordance with the Contract Documents.

3. The Owner hereby agrees to pay to the Contractor for the faithful performance of this Agreement, and the Contractor hereby agrees to perform all of the Work, for the sum of _____ Dollars (\$_____) in the lawful money of the United States, subject to adjustments as provided for in the Contract Documents. Payment of the Contract Price shall be in accordance with Articles 20 and 21 of the General Conditions.

4. It is further mutually agreed between the parties hereto that if at any time after the execution of this Agreement and the Performance Bond and Labor and Material Payment Bond hereto attached for its faithful performance, the Owner shall deem the surety or sureties upon such Bonds to be unsatisfactory, or if, for any reason, such Bonds or either of them cease to be adequate to cover the performance of and payment for the Work, the Contractor shall, at its expense, within five (5) days after notice from the Owner 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 Owner. In such event no further payment to the Contractor shall be deemed to be due under this Agreement until such new or additional security for the faithful performance of or payment for the Work shall be furnished in a manner and form satisfactory to the Owner.

5. Terms used in this Agreement which are defined in the Contract Documents shall have the meanings designated in those Contract Documents.

6. The Contractor agrees to indemnify and hold harmless the Owner against liability for damages arising out of bodily injury including death, or property damage, to any person or persons only to the extent that the fault of the Contractor or its derivative parties is a proximate cause of the loss, damage, or expense to be indemnified. This obligation to indemnify includes the obligation to pay any attorney's fees, litigation expenses, or court costs actually incurred by Owner to the extent that the fault of the Contractor or its derivative parties is a proximate cause of the fees, expenses, or cost to be indemnified. It is the intent of this provision to require the Contractor to indemnify the Owner to the fullest extent permitted by North Carolina law. The language and definitions in this section shall be construed consistent with N.C.G.S. 22B-1 et seq. as it may be amended. The indemnification obligation under this paragraph shall not be limited in any way by any limitation of the amount or type of damages, compensation or benefits payable by or for the Contractor or any subcontractor under workers' compensation acts, disability benefits acts or other employee benefit acts.

7. The laws of the State of North Carolina shall apply to the interpretation and enforcement of this Agreement. Any and all suits or actions to enforce, interpret or seek damages with respect to any provision of, or the performance or nonperformance of, this Agreement shall be brought in the General Court of Justice of North Carolina sitting in Wake County, North Carolina, or the United States District Court sitting in Wake County, North Carolina, and it is agreed by the parties that no other court shall have jurisdiction or venue with respect to such suits or actions.

8. To ensure compliance with the E-Verify requirements of the General Statutes of North Carolina, all contractors, including any subcontractors employed by the contractor(s), by submitting a bid, proposal or any other response, or by providing any material, equipment, supplies, services, etc, attest and affirm that they are aware and in full compliance with N.C.G.S. Chapter 64, Article 2 (N.C.G.S. 64-26(a)) relating to the E-Verify requirements.

9. By signing this agreement; accepting this contract/purchase order; or submitting any bid, proposal, etc., vendors and contractors certify that as of the date of execution, receipt, or submission they are not listed on the Final Divestment List created by the NC Office of State Treasurer pursuant to NCGS 147 Article 6E, Iran Divestment Act, Iran Divestment Act Certification. Vendors and contractors shall not utilize any subcontractor that is identified on the Final Divestment List.

Any organization defined under NCGS 147-86.80(2), Divestment from Companies Boycotting Israel, shall not engage in business totaling more than \$1,000 with any company/business, etc. that boycotts Israel. A list of companies that boycott Israel is maintained by the NC Office of State Treasurer, pursuant to NCGS 147-86.81(a)(1). Any company listed as boycotting Israel is not eligible to do business with any State agency or political subdivision of the State.

10. If the source of funds for this contract is federal funds, the following federal provisions apply pursuant to 2 C.F.R. § 200.326 and 2 C.F.R. Part 200, Appendix II (as applicable):

Equal Employment Opportunity (41 C.F.R. Part 60); Davis-Bacon Act (40 U.S.C. 3141-3148); Copeland "Anti-Kickback" Act (40 U.S.C. 3145); Contract Work Hours and Safety Standards Act (40 U.S.C. 3701-3708); Clean Air Act (42 U.S.C. 7401-7671q.) and the Federal Water Pollution Control Act (33 U.S.C. 1251-1387); Debarment and Suspension (Executive Orders 12549 and 12689); Byrd Anti-Lobbying Amendment (31 U.S.C. 1352); Procurement of Recovered Materials (2 C.F.R. § 200.322); and Record Retention Requirements (2 CFR § 200.324).

11. In consideration of signing this Agreement, the Parties hereby agree not to discriminate in any manner on the basis of race, natural hair or hairstyles, ethnicity, creed, color, sex, pregnancy, marital or familial status, sexual orientation, gender identity or expression, national origin or ancestry, marital or familial status, pregnancy, National Guard or veteran status, religious belief or non-belief, age, or disability with reference to the subject matter of this Contract. The Parties agree to comply with the provisions and intent of Wake County Ordinance SL 2017-4. This anti-discrimination provision shall be binding on the successors and assigns of the Parties with reference to the subject matter of this Contract.

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

Contractor: (Trade or Corporate Name)

By: _____

Title: _____
(President)

ATTEST: (CORPORATION)

By: _____

Title: _____
(Corporate Secretary)

(CORPORATE SEAL)

WITNESS:

(Proprietorship or Partnership)

WAKE COUNTY
P. O. Box 550
Raleigh, N.C. 27602

By: _____
County Manager or Designee

This instrument has been pre-audited in the manner required by the local Government Budget and Fiscal Control Act.

Wake County Finance Officer

This instrument has been reviewed by Wake County Facilities, Design & Construction

Mark Forestieri
Director, Facilities Design & Construction

The person responsible for monitoring the contract performance requirements is

_____. _____ Department Head Initials

PAYMENT BOND

Date of Contract: _____

Date of Execution: _____

Name of Principal:
(Contractor) _____

Name of Surety: _____

Name of Contracting Body: County of Wake
P.O. Box 550
Raleigh, N.C. 27602

Amount of Bond: _____
Dollars (\$ _____)

Project: _____

KNOW ALL MEN BY THESE PRESENTS, that we, the PRINCIPAL and SURETY above named, are held and firmly bound unto the above named owner, hereinafter called "Owner", 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 Owner identified as shown above and hereto attached:

NOW THEREFORE, if the Principal shall promptly make payment to all persons supplying labor and 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 modification 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 representatives, pursuant to authority of its governing body.

PAYMENT BOND

Executed in Four (4) Counterparts.

CONTRACTOR:

By: _____

Title: _____
(Corporation President or
Vice President Only)

ATTEST: (Corporation)

(Corporation Secretary or Assistant
Secretary Only)

(CORPORATE SEAL)

SURETY COMPANY:

WITNESS: By: _____

(Attorney in Fact)

Title: _____

(SURETY CORPORATE SEAL)

COUNTERSIGNED:

(N.C. Licensed Resident Agent)

Name and Address-Surety Agency

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

PERFORMANCE BOND

Date of Contract: _____

Date of Execution: _____

Name of Principal:
(Contractor) _____

Name of Surety: _____

Name of Contracting Body: County of Wake
P.O. Box 550
Raleigh, N.C. 27602

Amount of Bond: _____
Dollars (\$ _____)

Project: _____

KNOW ALL MEN BY THESE PRESENTS, that we, the PRINCIPAL and SURETY above named, are held and firmly bound unto the 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 countersigned representative, pursuant to authority of its governing body.

PERFORMANCE BOND

Executed in Four (4) Counterparts.

CONTRACTOR:

By: _____

Title: _____
(Corporation President or
Vice President Only)

ATTEST: (Corporation)

(Corporation Secretary or Assistant
Secretary Only)

(CORPORATE SEAL)

SURETY COMPANY:

WITNESS: By: _____

(Attorney in Fact)

Title: _____

(SURETY CORPORATE SEAL)

COUNTERSIGNED:

(N.C. Licensed Resident Agent)

Name and Address-Surety Agency

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



GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

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GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

ARTICLE 1.

DEFINITIONS

- 1.1 Agreement - The Construction Agreement, these General Conditions, and any Supplementary Conditions.
- 1.2 AIA - The American Institute of Architects.
- 1.3 ASTM - The American Society for Testing and Materials.
- 1.4 Beneficial Occupancy – The point at which the Project can be occupied by the Owner for its intended purpose, upon achievement of Substantial Completion, as defined in 1.40.
- 1.5 Change Order - A written order to the Contractor signed by the Owner and the Designer authorizing an addition, deletion, or revision in the Work and/or an adjustment in the Contract Price and/or the Contract Time issued after execution of the Construction Agreement. See paragraph 14.1.
- 1.6 Completion Date - Those dates identified as Completion Dates in the Contract Construction Schedule or elsewhere in the Contract Documents.
- 1.7 Construction Agreement – The document executed by the Contractor and the Owner to formally memorialize their consent to the terms of the Agreement.
- 1.8 Construction Change Directive – A written order to the Contractor signed by the Owner and the Designer directing an addition, deletion, or revision in the Work after execution of the Construction Agreement, in circumstances when the parties have been unable to agree on an adjustment to the Contract Price or the Contract Time, but the Owner requests that the Contractor proceed with said Work subject to adjustment of the Contract Price and/or Contract Time under the procedures described herein.
- 1.9 Construction Manager(s) - The person or firm designated as the Construction Manager in the Contract Documents, or their authorized representatives. The Construction Manager(s), as referred to herein, will be referred to hereinafter as if each were of the singular number, masculine gender.
- 1.10 Contract Construction Schedule - That schedule described in Article 13 hereof and identified as the Contract Construction Schedule.
- 1.11 Contract Documents - All of the documents that make up the Agreement, plus the Drawings and Specifications that describe the scope of the Work, plus allowable Modifications to the Contract Documents.
- 1.12 Contract Price - The total monies payable to the Contractor under the Contract Documents pursuant to paragraph 15.1 of the Agreement.
- 1.13 Contract Time - The number of calendar days stated in, or computed from, the Contract Documents for the completion of the Work, or any portion thereof. See, particularly, Article 13 hereof and the Contract Construction Schedule. Time of completion as specified therein is of the essence. The time used and referred to on the Project will be that time which is



GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

observed in Raleigh, North Carolina, being Eastern Daylight Savings Time (EDT), Eastern Standard Time (EST), or other as designated by the Designer.

- 1.14 Contractor - The Contractor shall be that party identified as such in the Agreement.
- 1.15 Days - Unless otherwise indicated, the term "days" shall mean consecutive calendar days.
- 1.16 Daylight Hours - The hours or portions of hours between sunrise and sunset local time.
- 1.17 Designer(s) – The person or firm designated as the Designer in the Contract Documents, or their authorized representatives. The Designer(s), as referred to herein, shall mean architect, landscape architect, and/or engineer. They will be referred to hereinafter as if each were of the singular number, masculine gender.
- 1.18 Drawings - The Drawings are the graphic and pictorial portions of the Contract Documents, wherever located and whenever issued, showing the design, location, and dimensions of the Work, and generally including plans, elevations, sections, details, schedules and diagrams. A list of the Drawings is contained in the Supplemental General Conditions.
- 1.19 Field Order - A written order issued by the Designer which clarifies or interprets the Contract Documents or orders minor changes in the Work in accordance with the Contract Documents. See paragraph 14.2.
- 1.20 Final Completion - The point at which the Contractor has, as determined by the Designer, completed the Work, with the exception of guaranty and warranty obligations, and becomes entitled, upon the recommendation of the Designer and determination by the Owner, to final payment.
- 1.21 The words "furnish," "furnish and install," "install," and "provide" or words with similar meanings shall be interpreted, unless otherwise stated, to mean furnish and install complete, in place and ready for service.
- 1.22 Liquidated Damages – See paragraph 13.18 of these General Conditions.
- 1.23 Modification - (A) a written amendment to the Contract Documents signed by the Owner and the Contractor and identified therein as such, (B) a Change Order, (C) Construction Change Directive, or (D) a Field Order. A Modification may only be issued after execution of the Agreement.
- 1.24 Notice of Award - The written notice by the Owner to the Contractor that the Contractor is the successful Bidder and that upon compliance with the conditions precedent to be fulfilled by the Contractor within the time specified, the Owner will execute and deliver the Agreement to him.
- 1.25 Notice to Proceed - See paragraph 13.3.
- 1.26 Owner - The Owner is the person designated as such in the Agreement.



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- 1.27 Owner's Authorized Representative - A person, or persons, employed by the Owner and designated from time to time by written notice to the Contractor to administer the Contract Documents, and to observe and monitor the Work on behalf of the Owner with authority and responsibility as herein specified.
- 1.28 Notice - The term "notice" or "written notice" as used herein shall mean and include all written notices, demands, instructions, and claims approvals and disapprovals furnished by the Owner or the Designer to obtain compliance with the requirements of the Contract Documents, as well as all written notices, demands, instructions and claims furnished by the Contractor as required by the Contract Documents. Where notice is required under the terms of the Contract Documents written notice shall always be required, and oral or "constructive" notice shall be insufficient and ineffective as notice. Email or other electronic delivery shall be insufficient and ineffective as notice unless specifically allowed by the Supplementary Conditions or a Modification to the Agreement. Written notice shall be deemed to have been duly served on the date that it is delivered in person to the individual or to a member of the firm, to an officer of the corporation for whom it is intended, to an authorized representative of such individual, firm, or corporation, or on the date that it is mailed by registered or certified mail, return receipt requested, addressed to the last business address of such individual, firm, or corporation known to the person giving the notice. Written notice may also be given by facsimile transmission, provided that proof of delivery is obtained. In the case of delivery in person, such delivery shall not be effective unless and until a written and signed receipt showing the date and time of delivery is obtained.
- 1.29 Project - The total construction of which the Work performed under the Contract Documents may be the whole or a part.
- 1.30 Project Expediter – As used herein, is an entity stated in the Contract Documents, designated to effectively facilitate scheduling and coordination of Work activities. For the purpose of a single prime contract, the single prime contractor is designated as the Project Expediter. For the purpose of a project involving separate prime contracts, the Contractor for general work shall be designated as the Project Expediter unless otherwise indicated in the Supplementary General Conditions. See paragraph 7.27.
- 1.31 Project Manager - That person designated by the Contractor in accordance with paragraph 7.2 who shall be in general charge of the Work and its performance and who shall have the authority set forth in the last sentence of paragraph 7.2.
- 1.32 Request for Information - A written communication from the Contractor to the Designer for any interpretation of, or information needed, required, or desired under the Contract Documents. The Owner reserves the right to determine the reasonable format and contents required for a Request for Information. In any Request for Information, the Contractor shall state a reasonable date by which a response is necessary in order to avoid delay in progress on the Work and shall make such request sufficiently in advance of such date as to avoid any such delay. The Designer shall respond in writing to the Request for Information by the date stated by the Contractor unless he cannot reasonably do so, in which case he shall prior to that date notify the Contractor of the date by which he can reasonably respond. The Contractor shall not be entitled to any additional time for the completion of the Work or any portion thereof by reason of the Designer's failure to respond



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if he has not submitted his Request for Information sufficiently in advance to allow the Designer a reasonable time within which to respond.

- 1.33 Request for Payment - The form, in the form of AIA Document G702 (latest ed.) or other published document approved by Owner, which is to be used by the Contractor in requesting progress payments and which is to include a Schedule of Values as required by the Contract Documents and an affidavit of the Contractor that progress payments theretofore received from the Owner on account of the Work have been applied by the Contractor to discharge in full all the Contractor's obligations incurred in connection with Work covered by all prior applications for payment. See paragraph 20.2.
- 1.34 Resident Superintendent - That person designated by the Contractor in accordance with paragraph 7.2 who has day-to-day responsibility for the prosecution of the Work and the obtaining of proper materials and equipment, and adequate labor and who shall have the authority set forth in the last sentence of paragraph 7.2.
- 1.35 Schedule of Values - Any breakdown of the Contract Price which may be required by the Contract Documents, and designated as such. See paragraph 20.1.
- 1.36 Specifications - That portion of the Contract Documents consisting generally of the written requirements for materials, equipment, construction systems, standards, and workmanship for the Work and performance of related services.
- 1.37 Subcontractor - A person, firm, or corporation who has entered into a direct contract with the Contractor to perform any of the Work at the Project.
- 1.38 Submittal - Shop drawings, product data, samples, and other documents required by the Contract Documents to be submitted by the Contractor to the Designer.
- 1.39 Submittal Register - See paragraph 13.2 of these General Conditions.
- 1.40 Substantial Completion - The point at which the Work, and Work by other Contractors on or in connection with the Project, as determined by the Designer, is sufficiently complete in accordance with the Contract Documents that it can be beneficially occupied by the Owner, and the Work can be utilized by the Owner for its intended use, and all necessary permits and permissions for Beneficial Occupancy and utilization having been obtained by the Contractor. All operations and maintenance manuals, Owner training, and as-built drawings must be submitted prior to Substantial Completion being achieved.
- 1.41 Sub-subcontractor - A person or entity that has a direct or indirect contract with a Subcontractor to perform any of the Work at the Project.
- 1.42 Work - The construction and services required by the Contract Documents, including all labor, materials, equipment, and services provided or to be provided by the Contractor to fulfill the Contractor's obligations.
- 1.43 All references in the Contract Documents to the masculine shall be interpreted as including the feminine or neuter and all references in the Contract Documents to the singular or the



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plural shall be interpreted as including the other, as may be appropriate in the reasonable interpretation of the Contract Documents.

ARTICLE 2. CORRELATION, INTERPRETATION AND INTENT OF CONTRACT DOCUMENTS

- 2.1 It is the intent of the Specifications and Drawings and other Contract Documents to describe a complete Project in accordance with the Contract Documents.
- 2.2 The Contract Documents are complementary; what is called for by one is as binding as if called for by all. If the Contractor finds a conflict, error or discrepancy in the Contract Documents, the Contractor shall notify the Designer in writing before proceeding with the Work affected thereby. In resolving such conflicts, errors and discrepancies, the Contract Documents shall be given preference in the following order: Construction Agreement, Modifications, Addenda, Supplemental Conditions, General Conditions, Specifications, and Drawings. Figure dimensions on Drawings shall govern over scale dimensions, and detailed Drawings shall govern over general Drawings. Any Work that may reasonably be inferred from the Contract Documents as being required to produce the intended result shall be supplied whether or not it is specifically called for. Work, materials or equipment described in words which, so applied, have a well known technical trade meaning shall be deemed to refer to such meaning and to incorporate any recognized standards which are a part of such meaning.
- 2.3 Miscellaneous items, accessories and work which are not specifically mentioned, but which are essential to produce a complete and properly operating installation, or useable structure or plant providing the indicated function shall be furnished and installed without change in the Contract Price. Such miscellaneous items and accessories shall be of the same quality standards, including material, style, finish, strength, class, weight and other applicable characteristics, as specified for the major component of which the miscellaneous item or accessory is an essential part, and shall be approved by the Designer before installation. This requirement is not intended to include major components not covered by or inferable from the Contract Documents.
- 2.4 The Work of all trades under the Contract Documents shall be coordinated by the Contractor in such a manner as to obtain the best workmanship possible for the entire Project and all components of the Work shall be installed or erected in accordance with the best practices of the particular trade.
- 2.5 The Contractor shall fully complete the Work and shall be responsible for all of the Work under the Contract Documents to which the Construction Agreement applies. If the Contractor is prevented from doing so by any limitation of the Contract Documents, the Contractor shall immediately give notice thereof to the Designer and the Owner in writing before proceeding with the construction in the area where the problem or limitation exists.
- 2.6 Standard specifications or manufacturers' literature, when referenced, shall be of the latest revision or printing unless otherwise stated and is intended to establish the minimum requirements acceptable.



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- 2.7 For those materials specified without the use of brand names, the Contractor shall submit within thirty (30) days after his receiving the Construction Agreement for signatures, any product that meets the express requirements of the Specifications.
- Such Submittal shall include manufacturer's data, test reports, performance data and certifications, samples, erection details, and other applicable information as required to permit determination by the Designer whether such proposed products are suitable. The Designer shall be the sole judge as to the suitability of any proposed product. The burden of proof of quality rests with the Contractor.
- 2.8 The Contractor is required to examine and read the complete set of Contract Documents for information concerning the Work, because some of the Work for which the Contractor will be responsible may be indicated on or in documentation applying primarily to the Work of one or more other separate prime contractors. No allowance will be made for the Contractor's failure to become familiar with the complete set of project documents.
- 2.9 Contractor's requests for clarification or information shall clearly define the cause(s) of Contractor's request and, as appropriate, shall include Contractor's interpretation and Contractor's proposed solution.

ARTICLE 3. FAMILIARITY WITH WORK, CONDITIONS AND LAWS

- 3.1 The Contractor has investigated prior to bidding and is satisfied with all conditions affecting the Work, including but not restricted to those bearing upon transportation, disposal, handling and storage of materials, availability of labor, water, electrical power, roads and uncertainties of weather, or similar physical conditions at the Project site, and the character of equipment and facilities needed prior to and during prosecution of the Work. The Contractor is satisfied as to the character, quality and quantity of surface and subsurface materials or obstacles to be encountered insofar as this information is reasonably ascertainable from inspection of the Project site, including all exploratory work done by the Owner, as well as from information presented by the Contract Documents, or any other information made available to the Contractor prior to receipt of bids. Any failure by the Contractor to become acquainted with the available information shall not relieve the Contractor from the responsibility for estimating properly the difficulty or cost of successfully performing the Work.
- 3.2 The Contractor shall be entitled to rely upon all information furnished to the Contractor in writing by the Owner with respect to the Project site and to make all inferences from it that would reasonably be made by a contractor having knowledge and experience with similar work; however, the Contractor shall not be entitled to infer from Owner-supplied information any fact or condition which would not be inferred by a contractor having knowledge and experience with similar work and, if the Owner-supplied information is inadequate or insufficient in any respect, the Contractor shall be required to obtain independently such other information as a knowledgeable and experienced contractor would prudently obtain in order to evaluate any such condition.
- 3.3 The Contractor specifically acknowledges familiarity with all Federal, State, and local laws, ordinances, rules, and regulations which may in any manner affect those engaged or



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employed in the Work, or the materials or equipment in or about the Work, or in any way affect the conduct of the Work and agrees that the Contractor and the Contractor's employees, subcontractors, and suppliers will, at all times, comply with same. If the Contractor shall discover any provisions in the Contract Documents which are contrary to or inconsistent with any such law, ordinance, rule, or regulation, the Contractor shall immediately give notice thereof to the Designer and the Owner in writing, identifying any items of Work affected, and the Contractor shall not proceed until the Contractor has received written direction from the Designer with respect to these items. If the Contractor performs contrary to or inconsistently with any such law, ordinance, rule, or regulation without giving such notice, the Contractor shall bear all costs which are a consequence of such performance.

- 3.4 At times selected by the Designer after execution by the Contractor of the Construction Agreement, a pre-construction conference shall be scheduled and conducted for the benefit of the Project.

ARTICLE 4. BONDS

- 4.1 A performance bond in the full amount of the Contract Price shall be required of the Contractor to guarantee the faithful performance of the Work in compliance with the Contract Documents, in such form as may be required by law and approved by the Owner. The bond shall be dated the same date as the Construction Agreement and must be accompanied by a current copy of the power of attorney for the attorney-in-fact executing such bond on behalf of a surety company licensed to do business in the state of North Carolina.
- 4.2 A payment bond in the full amount of the Contract Price shall be required of the Contractor to guarantee the payment of all labor and material costs or claims in connection with compliance with the Contract. The payment bond shall be in such form as may be required by law and approved by the Owner. Said bond shall be dated and executed in the same manner as the performance bond in paragraph 4.1.

ARTICLE 5. INSURANCE AND INDEMNITY

5.1 CONTRACTOR PROVIDED INSURANCE

The Contractor shall, without limiting its obligations or liabilities, procure, pay for and maintain such insurance as is required by law and as is required by this Agreement to protect the Contractor and the Owner from claims for damages for bodily injury, including death, and from claims for property damage which may arise from the Contractor's or its representatives', consultants', Subcontractors', agents', or employees' operations under this Agreement. Such insurance shall be of the kinds and have limits of liability and coverages not less than the minimum limits hereinafter specified or required by law, whichever is greater. The Owner makes no representation as to the adequacy or sufficiency of such coverages. The following requirements shall in no way be construed to limit or eliminate the liability of the Contractor, which arises from performance of Work under the Agreement. The Contractor is strictly responsible for any losses, claims, and costs of any kind which exceed the Contractor's limits of liability, or which may be outside the coverage scope of the policies.



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The insurance specified shall be provided by an insurer approved by the Owner, authorized to do such business in the State of North Carolina, and on terms approved by the Owner. Insurance companies utilized shall have a minimum rating of A- and Class VII as evaluated by the most current A.M. Best Rating Guide. If the insurer has a Best Rating less than A- and Class VII, the Contractor must receive specific written approval from the Owner prior to proceeding with any Work under the Agreement. All agents and brokers shall hold valid licenses from the State of North Carolina. Before commencing mobilization to the Project site and not later than 7 days after the receipt of the Construction Agreement by the Contractor for signatures, the Contractor shall furnish to the Owner a certificate or certificates of insurance in a form satisfactory to the Owner. Upon request of the Owner, the Contractor shall provide the Owner with certified copies of the insurance policies required by this Article, including without limitation declaration pages, conditions, exclusions and endorsements, and confirmation that each policy premium has been paid for the required term of this Agreement. A copy of the umbrella policy shall be provided to the Wake County Finance Department. Certificates shall be signed by a person authorized by that insurer to bind coverage on its behalf. In the event of any such cancellation, non-renewal, reduction, restriction, or change in any insurance, the Contractor is obligated to replace such insurance within 7 days without a gap in coverage and file accordingly such notice with the Owner, and other interested parties. Failing immediate receipt of evidence of such replacement of insurance the Owner reserves the right to procure such insurance as the Owner considers desirable and the Contractor shall pay or reimburse the cost of the premium in respect thereof. It is expressly provided, however, that any action or inaction on the part of the Owner in this respect shall in no way change or reduce the Contractor's responsibilities and liabilities under this Agreement. Self-funded, policy fronting, or other non-risk transfer insurance mechanisms are not acceptable without prior written approval of the Owner. Full disclosure of such a program must be made prior to commencing mobilization to the Project site. Failure to make a full disclosure constitutes a material breach of the Agreement, justifying termination for default.

The Contractor shall name the Owner, the Designer, the Designer's consultants, and the Construction Manager as additional insureds under all its insurance contracts (except workers' compensation) with respect to and including without limitation liability arising out of activities performed by or on behalf of the Contractor, products and completed operations of the Contractor, and automobiles owned, hired, leased, or borrowed by the Contractor. The coverage shall contain no special limitations on the scope of protection afforded to additional insureds.

For any claims related to this Project, the Contractor's insurance or self insurance shall be primary and noncontributory with respect to the Owner's insurance. Any insurance or self-insurance maintained by the Owner shall be excess and noncontributory with respect to the Contractor's insurance.

All policies of insurance shall contain a clause waiving rights of subrogation against the Owner, unless the Owner approves otherwise in writing.

Limits of coverage are not to be amended by deductible clauses of any nature without the express written consent of the Owner. The Contractor shall be solely responsible for any deductible assumptions that may exist in any insurance policies required under this



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Agreement. In addition, the Contractor shall be responsible and shall not be reimbursed for any losses arising from any risk or exposure not insured as required herein, or not covered as a result of a normal policy exclusion or that falls within the self insured retention, if Contractor self insured.

The Contractor's insurance shall apply separately to each insured against whom claim is made or suit is brought, except with respect to the limits of the insurer's liability.

The claim provisions in the Contractor's insurance policies must specifically state the insurance company or Contractor's Third Party Administrator, if self insured, has both the right and duty to adjust a claim and provide defense.

The policies shall not contain any provision or definition which would serve to exclude or eliminate from coverage third party claims, including exclusions of claims for bodily or other injury to shareholders, partners, officers, directors, or employees of the insured, the premises owner, real estate manager, or the insured's Subcontractor, or any family relative of such persons.

If the policies contain any warranty stating that coverage is null and void (or words to that effect) if the Contractor does not comply with the most stringent regulations governing the Work, it shall be modified so that coverage shall be afforded in all cases except for the Contractor's willful or intentional noncompliance with applicable government regulations.

Any failure by any person to comply with reporting or other provisions of the policy including breach of warranties, shall not affect coverage provided to the Owner and its representatives, officials, and employees.

The insolvency or bankruptcy of the Insured or of the Insured's estate shall not relieve the insurance companies of their obligations under these policies. Any clauses to the contrary are unacceptable and must be stricken.

Failure to comply with these requirements shall be a material breach of this Agreement justifying termination for default.

5.1.1 Worker's Compensation and Employers' Liability Insurance

The Contractor and its Subcontractors shall procure and maintain Workers' Compensation Insurance in the amount and type required by the State of North Carolina and federal law for all employees employed under the Agreement who may come within the protection of Workers' Compensation Laws and covering all operations under the Agreement whether performed by the Contractor or by his Subcontractors. In jurisdictions not providing complete Workers' Compensation protection, the Contractor and his Subcontractors shall maintain employers' liability insurance in an amount, form, company, and agency satisfactory to the State of North Carolina and the Owner for the benefit of all employees not protected by Workers' Compensation Laws and covering all operations under the Agreement whether performed by the Contractor or by his Subcontractors.

The Contractor shall pay such assessments as will protect the Contractor and the Owner from claims under the Workers' Compensation Laws, workers' or workmen's compensation



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disability benefits, and other similar employee benefit acts. The current Experience Modification Factor shall be indicated on the Certificate of Insurance.

Coverage under this section shall be as required by federal and state Workers' Compensation and Occupational Disease Statutes, and shall have minimum limits as follows:

Coverage A:	Statutory, State of North Carolina
Employers' Liability:	Each Accident \$1,000,000
	Disease - Policy Limit \$1,000,000
	Disease - Each Employee \$1,000,000

Such insurance shall include Voluntary Compensation coverage, a Waiver of Subrogation in favor of the Owner as well as other endorsements that may be required by applicable jurisdictions, i.e. United States Longshoremen and Harbor Workers Act and maritime coverage (Jones Act).

5.1.2 Automobile Liability Insurance

The Contractor shall procure and maintain automobile insurance against liability for bodily injury and property damage as described below, that may arise with respect to the Work being performed under the Agreement, and as will provide protection from claims which may arise out of or result from the Contractor's performance of the Work and the Contractor's other obligations under the Agreement, whether such performance of the Work is by the Contractor, by any representative or Subcontractor, by anyone, both officially and personally, directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable.

This policy of insurance shall carry the following minimum Limit of Liability:

Combined Single Limit	\$1,000,000

The policy of insurance shall contain or be endorsed to include the following:

- a) owned, hired, and non-owned automobile liability.
- b) If the policy contains a warranty stating that coverage is null and void (or words to that effect) if the transporter does not comply with the most stringent regulations governing the Work, it shall be modified so that coverage shall be afforded in all cases except for the transporter's willful or intentional noncompliance with applicable government regulations.

Any failure by any party to comply with reporting or other provisions of the policy including breach of warranties, shall not affect coverage provided to the Owner and its representatives, officials, and employees.

No subcontracting of waste hauling shall be permitted without prior, written approval of the Owner.



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5.1.3 General Liability

This policy must be written on an Occurrence basis, with the following minimum Limits of Liability:

General Aggregate per project	\$2,000,000.00
Products/Completed Operations Aggregate	\$2,000,000.00
Bodily Injury and Property Damage csl/each occurrence	\$1,000,000.00
Personal Injury and Advertising Injury	\$2,000,000.00

The policy of insurance shall contain or be endorsed to include the following:

- a) Blanket Contractual Liability covering Contractor's indemnification obligations under this Agreement, in accordance with ISO policy form CG 00 01. Modifications to the standard provision will not be acceptable if they serve to reduce coverage.
- b) Premises/Operations Liability.
- c) Explosion, collapse, and underground fault.
- d) Independent Contractors and Independent Subcontractors coverage.
- e) Broad Form Property Damage.
- f) Personal Injury
- g) Cross Liability/Severability of Interest clause.
- h) Employer's Stop-Gap Liability endorsement, if applicable.
- i) Amendment of the Pollution Exclusion Endorsement to allow coverage for bodily injury or property damage caused by heat, smoke, or fumes from a hostile fire.
- j) Designated General Aggregate Limit Endorsement if required by the Supplemental General Conditions.

Coverage shall remain continuously in effect and without interruption for at least 6 years from the date of the Notice of Award and shall include coverage for exposures arising from operations that have been completed. The Contractor shall furnish the Owner and each other additional insured listed in the Agreement to whom the Certificates have been issued, evidence satisfactory to the Owner of continuation of such insurance at the date of Preliminary Acceptance and each year thereafter.

5.1.4 Pollution Legal Liability (PLL)

Pollution Legal Liability coverage will be provided if required by the Supplementary General Conditions.

5.1.5 Umbrella Liability



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The Contractor shall maintain an occurrence basis (as distinguished from a "claims made" basis) Umbrella Liability policy (true follow form) over the underlying General Liability, Automobile Liability, and Employer's Liability, with the following limits of liability:

Each Occurrence	\$3,000,000
Aggregate	\$3,000,000

On a fully insured basis such coverage will be subject to a deductible no greater than \$10,000 per occurrence where coverage is not provided by the underlying insurance, but is provided by the Umbrella Liability policy.

The Contractor may use any combination of primary and umbrella insurance policies to comply with the insurance requirements, provided the resulting insurance is equivalent to the insurance stated herein.

All Occupational Disease exclusions must be deleted. Any Pollution Exclusion must be amended to allow coverage for bodily injury or property damage caused by spill, upset, overturn, heat, smoke, or fumes from a hostile fire.

5.1.6 Property Insurance

The Contractor shall purchase All Risk Property Insurance on a Completed Value Form in the names of the Owner, Contractor, Subcontractors, and sub-subcontractors as their interests may appear with limits as follows:

- a) Full insurance value of the Work, or
- b) Amount equal to the Contract Price for the Work, whichever is higher.

The Contractor is responsible for all physical damage to owned or rented machinery, tools, equipment, forms, and other items owned, rented or used by the Contractor and/or Subcontractor(s) in the performance of the Work. The insurance coverage evidencing such shall include a waiver of subrogation in favor of the Owner.

5.1.7 Valuable Papers And Records

The Contractor shall provide valuable papers and records insurance with coverage in an amount commensurate with project scope and set forth in the Supplementary General Conditions.

5.1.8 Claims

The Contractor shall notify the Owner within 24 hours of any claims or alleged claims received by the Contractor covered by any of the policies of insurance required in this Agreement. The Contractor shall provide a written copy of the claim or alleged claim to the Owner within 3 days of the Contractor's receipt of the claim or alleged claim. If a claim is



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settled to the satisfaction of the claimant, the Contractor shall submit a copy of the claimant's release to the Owner.

If a claim or alleged claim is rejected by the Contractor and/or its insurance company, the Contractor shall immediately report this fact to the Owner.

Should 30 days elapse after the claim or alleged claim has been received by the Contractor, and the Contractor is not able to report a settlement or rejection of the claim, it shall report to the Owner the steps being taken with respect to the claim.

Without limiting the foregoing, the Contractor shall notify in writing the county risk manager of any paid or incurred claims which may impair annual aggregate or general liability.

5.1.9 Deductibles and Self-insured Retentions

Any deductibles or self-insured retentions must be declared to and approved by the Owner. At the option of the Owner, either: the insurer shall reduce to a maximum of \$250,000 or eliminate such deductibles or self-insured retentions with respect to the Owner, or the Contractor shall provide evidence of collateral provided to insurers or procure a bond guaranteeing payment of losses and related investigations, claim administration, and defense expenses within the deductible or self-insured retention amount. Any self-insured retention or deductible amount on the policy shall not reduce the amount of collectible limits or liability.

5.1.10 Subcontractors

The Contractor shall include all Subcontractors as Insureds under its policies, or shall furnish separate certificates, policies, and endorsements for each Subcontractor the Contractor intends to use. If a Subcontractor does not take out insurance in his own name and the Contractor wishes to provide insurance protection for such Subcontractor and such Subcontractor's employees, the Contractor shall either (a) procure appropriate policies in the name of the Subcontractor, or (b) cause a rider or riders to be attached to the Contractor's policies which shall identify the Subcontractor thereby covered; provided, however, in the case of the latter option, such a rider need not be attached to the Contractor's workers' compensation policy if such policy by its terms is sufficiently broad to cover the employees of all Subcontractors performing Work under the Contract Documents. Except as otherwise approved by the Owner in writing, Limits of Liability and coverage scope must be at a minimum as stringent as required of the Contractor by the Contract Documents. All Work performed for the Contractor by any Subcontractor shall be pursuant to an appropriate agreement between the Contractor and the Subcontractor which shall contain provisions that waive all rights the contracting parties may have against one another for damages caused by fire or other perils covered by insurance as provided herein. Insurance monies received from any loss shall be divided as the respective interest of the parties affected shall appear.

5.2 OWNER CONTROLLED PROJECT SPECIFIC INSURANCE



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In the event the Owner elects to purchase project-specific insurance affording coverage to the Contractor and Subcontractors, the terms and conditions of such coverage shall be set forth in the Supplementary Conditions.

5.3 CONTRACTOR AS JOINT VENTURE

If the Contractor is completing this Project on a joint venture basis, both joint venture partners retain all liabilities assumed by this Agreement, individually and collectively. This may include, but is not limited to, all premiums due, deductibles/self-insured retentions, coinsurance provisions, claim provisions, insurance policy conditions, and indemnification provisions hereunder.

Evidence of a Blanket Joint Venture Endorsement must be obtained from the General Liability and Contractor's Pollution Legal Liability carriers of each joint venture partner for a period of 6 years after completion of the Project, substantially as follows:

With respect to "your work", and the "products-completed operations hazard", you are an insured for your liability arising out of the conduct of any partnership or joint venture of which you were a partner or member, even though this partnership or joint venture is not shown as a Named Insured in the Declarations. This coverage is excess over any available liability purchased specifically to insure the partnership or joint venture. This coverage will not inure to the benefit of any other party except you."

5.4 INDEMNIFICATION

The Contractor, to the fullest extent not expressly prohibited by law, shall defend, indemnify, and save harmless the Owner, the Designer, the Construction Manager and their respective officials, officers, employees, and agents from and against any and all liabilities (foreseeable or unforeseeable), penalties, fines, forfeitures, demands, claims, causes of actions, suits, judgments, and costs and expenses incidental thereto, (including, without limitation, amounts paid pursuant to investigations, defense or settlements, and reasonable attorneys' fees), which any or all of them may hereafter suffer, incur, be responsible for, or pay out as a result of but not limited to:

- a) bodily injury (including sickness, disease, or death) to any person including but not limited to, the Contractor's employees or its representatives while on the site of the Project; or
- b) actual or alleged damage (including loss of use) to any property (public or private, including the Project or other property on the Project site); or
- c) contamination of or adverse effects on the environment arising directly or indirectly out of or in connection with the performance of the Work, including but not limited to any hazardous or toxic waste, substance, or constituent of any substance subject to regulation under CERCLA, RCRA, TSCA, and other Federal and state authorities that is spilled, released, threatening to release, or disposed of or destroyed by the Contractor or its Subcontractors on or off the site of the Project or while in transport to or from the site; or



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- d) any violation or alleged violation of laws and regulations, arising out of or in any way connected with the Work,

caused in whole or in part by the Contractor, any Subcontractor or supplier or any representatives of the Contractor. The Contractor shall not be required to indemnify the Owner against losses resulting from a breach of this Agreement by the Owner or its other agents and contractors, or resulting from negligence, misconduct or violation of laws on the part of the Owner or its other agents and contractors.

The Contractor further agrees to obtain, maintain, and pay for such liability insurance coverages and endorsements as will insure the provisions of this paragraph. Furthermore, the Contractor agrees to be liable for and to indemnify and reimburse the Owner for all legal fees and disbursements paid or incurred to enforce the provisions of this paragraph. The indemnification obligations under this paragraph shall not be limited in any way by the amount or type of damages, compensation or benefits payable under worker's compensation acts, disability benefit acts, other employment benefit acts, or the amount of insurance carried or recovered.

The Owner acknowledges that hazardous or toxic waste, material, chemicals, compounds or substances, or other environmental hazards, contamination or pollution, (referred to hereinafter as "environmental hazards") may be present at the Project site that were not created, generated, or released at the Project site by the Contractor or its Subcontractors, agents or employees, acting alone or in concert with others. Unless the remediation, abatement or handling of such environmental hazards is part of the scope of the Work under this Agreement, then upon the discovery of such environmental hazards, the Contractor shall immediately, and in no event more than three days later, give notice to the Owner of the environmental hazards before they are disturbed. The Owner and the Designer shall thereupon promptly investigate the environmental hazards, and make such changes in the Drawings and/or Specifications as they may find necessary to abate, remediate, isolate or handle the environmental hazards. Any increase or decrease in the Contract Price or the Contract Time resulting from such changes shall be adjusted in the manner provided herein for adjustments as to extra and/or additional Work and changes. It is agreed that the Contractor shall have no liability under this Agreement for any environmental hazards existing prior to the date that Work commences under this Agreement unless the Contractor or its Subcontractors, agents or employees, acting alone or in concert with others, by their own negligence or misconduct, release or expose the Owner or third parties to the environmental hazards.

The provisions of this paragraph shall survive the termination or cancellation or completion of this Agreement.

ARTICLE 6. OTHER RECORD DOCUMENTS AND SUBMITTALS

- 6.1 The Designer shall furnish to the Contractor the number of copies of Drawings and Specifications stated in the Supplementary General Conditions. Additional copies of Drawings and Specifications may be obtained at the cost of reproduction and handling.



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- 6.2 The Contractor shall submit to the Designer all Submittals required by the Contract Documents. The Contractor shall submit three (3) reproducible prints of all shop drawings plus the number of copies sufficient for his requirements. The Contractor shall submit samples in quantities required by the Contract Documents. The Contractor shall submit product data in five (5) copies, plus the number of copies sufficient for the Contractor's requirements. All shop drawings shall be reviewed by the Contractor and shall bear the Contractor's stamp of approval before being forwarded to the Designer. Submittals shall be submitted in such time as to cause no delay to the Work or any part thereof and in accordance with the Contract Construction Schedule and Submittal Register. The Designer shall review the submittal with reasonable promptness, noting desired corrections, if any. The Designer shall retain two (2) copies of the submittal and shall return the balance of the reviewed submittal to the Contractor for action. The Contractor shall furnish any corrected submittal to the Designer. The Designer shall retain two (2) copies of the corrected submittal and will return the balance of the reviewed submittal to the Contractor.

No substitutions will be accepted after the bids have been received. All substitutions prior to the receipt of bids shall be in accordance with the Contract Documents. Refer to Instructions to Bidders, Paragraph 3, Substitutions.

The Contractor acknowledges that the processing of shop drawings and other submittals is directly impacted by the clarity, completeness, and accuracy of said documents and that it is the Contractor's responsibility to (i) review and coordinate each submittal with all other related or affected Work and (ii) approve each submittal before submitting same to the Designer for approval.

- 6.3 No substitutions and no deviations from any requirement of the Contract Documents shall be deemed allowed unless the Contractor has specifically informed the Designer and the Owner in writing of such deviations at the time of submittal and the Designer and the Owner have given written and specific approval to the substitutions or deviations. In proposing a deviation or substitution the Contractor warrants to the Owner, notwithstanding any review, allowance or approval by the Designer or the Owner that the deviation or substitution is at least equal to or better in quality and for the purpose intended, and that Contractor shall not by reason of any such review, allowance or approval be relieved from any obligation or responsibility contained in the Contract Documents.
- 6.4 Review of submittal by the Designer shall not be construed as relieving the Contractor from responsibility for compliance with terms or designs of the Contract Documents nor from responsibility for errors of any sort in the submittal.
- 6.5 The Contractor shall keep one record copy marked "As-Built" of all Specifications, Drawings, Addenda, Modifications, and Submittals at the Project in good order and annotated at least monthly to show all changes made during the construction process. Such monthly annotations and their approval by the Designer shall be a condition precedent to approval by the Designer of each monthly Request for Payment. Said record copy shall be stored at the Project and fully protected from damage by fire or other hazard. This record copy shall be available to the Designer and Owner for inspection at all times and shall be delivered to the Designer for the Owner's purposes prior to the Designer's certifying Substantial Completion of the Work.



GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

- 6.6 At completion of the Project and before Final Payment, the Contractor shall assemble and deliver to the Owner one complete set of all as-built drawings and one complete set of all approved submittals, product data, and samples which were reviewed by the Designer. These drawings and submittals shall be on paper, or in electronic or other media if required by the Supplementary Conditions. These drawings and submittals shall be categorized and packaged as directed by the Designer.

ARTICLE 7. CONTRACTOR

- 7.1 The Contractor shall supervise and direct the Work efficiently and with the Contractor's best skill and attention. Except as may be set forth specifically in the Contract Documents, the Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction, and for safety precautions and programs in connection with the Work. The Contractor shall be responsible to see that the finished Work complies accurately with the Contract Documents.

- 7.2 The Contractor shall appoint a Project Manager and shall keep on the Project at all times during its progress a competent Resident Superintendent and necessary assistants who shall not be replaced without prior written approval by the Owner except under extraordinary circumstances, in which event immediate written notice shall be given to the Designer and the Owner. The Project Manager and the Resident Superintendent may be the same person or different persons. At any time, the Owner, in its sole and absolute discretion, may require the Contractor to replace the Project Manager or Resident Superintendent with an experienced and competent person or persons upon seven (7) days written notice from the Owner to the Contractor. Such replacement shall be at the Contractor's expense and at no cost to the Owner.

Both the Project Manager and the Resident Superintendent shall have authority to act on behalf of the Contractor, and instructions, directions or notices given to either of them shall be as binding as if given to the Contractor.

- 7.3 The Contractor shall provide sufficient competent and suitably qualified personnel, equipment, and supplies to lay out the Work and perform construction as required by the Contract Documents. The Contractor will at all times maintain good discipline and order at the site, and will comply with all applicable OSHA standards.

Any person employed by the Contractor, any Subcontractor, or any sub-subcontractor who, in the opinion of the Designer or the Owner, does not perform his Work in a proper and skillful manner or is intemperate or disorderly shall, at the written request of the Owner or Designer, be removed forthwith by the Contractor, Subcontractor, or sub-subcontractor employing such person without cost to the Owner, and shall not be employed again in any portion of the Work without the written approval of the Owner or Designer.

Should the Contractor fail to remove such person or persons or fail to furnish suitable and sufficient personnel for the proper prosecution of the Work within three (3) days after written order, the Owner may withhold further payment by written notice until compliance with such order.



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- 7.4 If, in the opinion of the Designer or the Owner, any Subcontractor on the Project is incompetent or otherwise unsatisfactory, he shall be replaced by the Contractor with no increase in the Contract Price if and when directed by the Designer or the Owner in writing.
- 7.5 The Contractor shall furnish all materials, equipment, labor, transportation, construction equipment and machinery, tools appliances, fuel, light, heat, and all other facilities and incidentals necessary for the execution, maintenance, initial operation, and completion of the Work, other than those specifically excluded by the Contract Documents and to be furnished by the Owner or others. When use or storage of hazardous materials or equipment or methods of more than ordinary risk are necessary in accomplishing the Work, the Contractor shall give the Owner and Designer reasonable advance notice.

If any materials are to be furnished or installed by the Owner or others under the terms of the Contract Documents, said materials shall be made available to the Contractor at the location(s) specified in the Contract Documents. All costs of handling, transportation from the specified location to the Project, storage, and installing of Owner-furnished materials shall be included in the Contract Price. The Contractor shall be responsible for any demurrage, damage, loss, or other deficiencies which may occur during the Contractor's handling, storage, or use of such Owner-furnished material. The Owner shall deduct from any monies due or to become due the Contractor any cost incurred by the Owner in making good any such damage, loss, or deficiency.

All equipment which is proposed to be used in the Work shall be of sufficient size and in such mechanical condition as to meet the requirements of the Work and produce a satisfactory quality of work. Equipment used on any portion of the Work shall be such that no injury to previously completed Work, adjacent property, or existing facilities shall result from its use.

When the methods and equipment to be used by the Contractor accomplishing the Work are not prescribed in the Contract Documents, the Contractor shall be free to use any methods or equipment that will accomplish the Work in conformity with the requirements of the Contract Documents.

When the Contract Documents specify the use of certain methods and equipment, such methods and equipment shall be used unless others are authorized by the Designer. If the Contractor desires to use a method or type of equipment other than specified in the Contract Documents, the Contractor may request authority from the Designer to do so. The request shall be in writing and shall include a full description of the methods and equipment proposed and of the reasons for desiring to make the change. If approval is given, it shall be on the condition that the Contractor shall be fully responsible for producing Work in conformity with the requirements of the Contract Documents. If, after trial use of the substituted methods or equipment, the Designer determines that the Work produced does not meet the requirements of the Contract Documents, the Contractor shall discontinue the use of the substitute method or equipment and shall complete the remaining Work with the specified methods and equipment at no additional cost to the Owner. The Contractor shall remove any deficient Work and replace it with Work of specified quality, or take such other corrective action as the Designer may direct. No change in the Contract Price or in Contract Time shall be made as a result of authorizing a change in methods or equipment under this paragraph.



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- 7.6 All materials and equipment shall be new, except as otherwise provided in the Contract Documents. When special makes or grades of material which are normally packaged by the supplier or manufacturer are specified or approved, such materials shall be delivered to the Project site in their original packages or containers with seals unbroken and labels intact.
- Materials shall be so stored as to assure the preservation of their quantity, quality and fitness for the Work. Stored materials, even though approved before storage, may again be inspected by the Designer or Owner prior to their use in the Work and shall meet the requirements of the Contract Documents at the time they are incorporated into the Work. Stored materials shall be located so as to facilitate their prompt inspection. The Contractor shall coordinate the storage of all materials with the Designer and the Owner. Materials to be stored at the Project or on the Owner's property shall not create an obstruction to the Owner's or other contractor's reasonable activities. Private property shall not be used for storage purposes without written permission of the owner or lessee of such property. The Contractor shall make all arrangements and bear all expenses for the storage of materials on private property. Upon request, the Contractor shall furnish the Owner a copy of the property owner's permission. All storage sites on private or the Owner's property shall be restored to their original condition by the Contractor at his entire expense, except as otherwise agreed to (in writing) by the owner or lessee of the property.
- 7.7 All materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned in accordance with the instructions of the applicable manufacturer, fabricator, or processor, except as otherwise provided in the Contract Documents.
- 7.8 The Contractor will be fully responsible for all acts and omissions of his Subcontractors and of persons directly or indirectly employed by them and of persons for whose acts any of them may be liable to the same extent that the Contractor is responsible for the acts and omissions of the Contractor's own employees. Nothing in the Contract Documents shall create any contractual relationship between any Subcontractor or supplier and the Owner or the Designer, or any obligation on the part of the Owner or the Designer to pay or see to the payment of any money due any such Subcontractor or material furnisher except as may otherwise be required by law. The Owner or the Designer may furnish to any Subcontractor or supplier, to the extent practicable, evidence of amounts paid to the Contractor on account of specific Work done.
- 7.9 The divisions and sections of the Specifications and the identifications of any Drawings shall not control the Contractor in dividing the Work among Subcontractors.
- 7.10 The Contractor agrees to bind specifically every Subcontractor to the terms and conditions of the Contract Documents for the benefit of the Owner and to furnish written evidence thereof to the Designer and the Owner within seven (7) days after written request by the Owner.
- 7.11 The Contractor shall attend job progress conferences and all other meetings or conferences as directed by the Designer. The Contractor shall be represented at these job progress conferences by a representative having the authority of the Project Manager and by such other representatives as the Designer may direct. Job progress conferences shall



GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

be open to Subcontractors, suppliers and any others who may contribute beneficially toward maintaining required job progress, and such personnel shall be encouraged by the Contractor to attend. It shall be the principal purpose of job progress 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 Work and the Project by the specified Completion Dates. The Contractor shall be prepared to assess progress of the Work as required in the Contract Documents and to recommend remedial measures for correction of progress as may be appropriate. The Designer shall preside as chairman and arrange for minutes to be taken and circulated.

In the event that the prosecution of the Work is discontinued for any reason, the Contractor shall notify the Designer and the Owner at least forty-eight (48) hours in advance of resuming operations.

Should the terms of the Contract Documents require completion of one or more portions of the Work for the Beneficial Occupancy of the Owner prior to completion of the entire Work, the Contractor shall complete such portion(s) of the Work on or before the date specified. Such completion shall include the obtaining of all government or other permits, permission, and/or approvals necessary to occupancy. The Contractor shall independently estimate the difficulties involved in arranging the Work to permit such Beneficial Occupancy and shall not claim any additional compensation or time extension by reason of any delay or increased cost due to completing such portion(s) of the Work. The Owner's possession and use of such portion(s) of the Work shall not be deemed an acceptance of any Work not completed in accordance with the Contract Documents. The Owner shall be responsible for the security, maintenance, utilities, and insurance of all portions of the Work completed and beneficially occupied by the Owner.

- 7.12 The Contractor shall pay all license fees and royalties, and assume all costs incident to the use of any invention, design process, or device which is the subject of patent rights or copyrights held by others, except for inventions, design processes, or devices specified by the Designer in the Contract Documents. The Contractor shall indemnify and hold harmless the Owner, the Designer, and anyone directly employed by either of them, from and against all claims, damages, losses and expenses, including attorney's fees and costs of defense, arising out of any infringement or alleged infringement of such rights during or after completion of the Work, and shall defend all such claims in connection with any actual or alleged infringement of such rights.
- 7.13 The Contractor shall secure and pay for all permits, including without limitation construction permits and licenses, and will pay all governmental charges and inspection fees necessary for the prosecution of the Work.
- 7.14 The Contractor shall give all notices and comply with all laws, ordinances, rules, and regulations applicable to the Work and shall protect and indemnify the Owner and the Owner's officers, agents, or servants against any claim or liability arising from or based on the violation of any such law, ordinance, regulation, order, or decree, whether by the Contractor or by the Contractor's employees, Subcontractors, sub-subcontractors, or their employees.



GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

- 7.15 The Contractor shall be responsible for the entire site of the Project and for its reasonable and necessary protection and security, as required by laws or ordinances governing such conditions, or by custom or sound construction practices, and shall share such responsibilities as may be agreed upon among them, or in the absence of such agreement, as may be directed by the Contract Documents, Owner, or Designer. The Contractor shall be responsible for any damage to the Owner's property, or that of others, by the Contractor or the Contractor's employees, Subcontractors, sub-subcontractors, or their employees or agents, and shall make good such damages. The Contractor shall be responsible for and pay for any such claims against the Owner.
- 7.16 The Contractor shall protect all landscaping designated to remain in the vicinity of the operations and barricade all walks, roads, and areas as necessary to keep the public away from the construction.
- 7.17 The Contractor shall provide cover and/or protect all portions of the Work and provide all materials necessary to protect the Work whether performed by the Contractor or any of the Subcontractors or sub-subcontractors. Any Work damaged through the lack of proper protection, or from any other cause, shall be repaired or replaced without extra cost to the Owner or extension to the Contract Time.

The Contractor shall maintain the Work during construction and until the Work is accepted. This maintenance shall constitute continuous and effective effort prosecuted day by day, with adequate equipment and forces so that the Work is maintained in satisfactory condition at all times. All costs of maintenance shall be included in the Contract Price and the Contractor will not be paid an additional amount for such effort. Should the Owner or Designer observe that the Contractor at any time has failed to maintain the Work as provided herein, the Designer may immediately notify the Contractor of such non-compliance. Such notification shall specify a reasonable time within which the Contractor shall be required to remedy such unsatisfactory maintenance condition. Should the Contractor fail to properly respond to the Designer's notification, the Owner may, at the Contractor's expense, take such action as it may deem appropriate to remedy the defective maintenance, including suspension of the Contractor's Work or any part thereof. Any such expense incurred by the Owner shall be deducted from monies due or to become due the Contractor.

Parking lots, streets, and walks connecting to the Project area shall be protected by the Contractor from deposits of mud, sand, stone, litter, or debris in any form.

Pedestrian traffic areas around the construction limits must be maintained in a clean and safe condition at all times with required barricades and covered walkways. When excavation or other operations outside the Project limits is required, the Contractor shall, immediately following that work, return the area to its original condition.

All catch basins and storm drain lines in the vicinity of the Project site shall be protected at all times from entry of dirt, rubble and other debris. The residue from the cleaning of trucks, wheelbarrows, concrete buggies, etc. must be prevented from entering the drainage system, and if cleaning is done, the residue must be contained and removed from the Project site with other refuse.



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- 7.18 No burning of refuse or debris shall be allowed inside or around the Project during the course of construction without written authority from authorities having jurisdiction and the Owner.
- 7.19 The Contractor shall provide for and maintain necessary safety measures and safety programs for the protection of all persons involved with the Work. Such measures and programs shall include the requirements of the most current edition of the CAGC Safety and Health Manual [or the AGC Accident Prevention Manual in Construction], or equivalent requirements, and shall fully comply with all Federal, State, and local laws, rules, regulations, and building code requirements relating to the prevention of accidents or injuries to persons on or about the location of the Work.
- All trenches, excavations, or other hazards in the vicinity of the Work shall be well barricaded, and properly lighted at night. When Work requires closing of an area normally used by the Owner or the public, the Contractor shall furnish, erect, and maintain temporary barricades, and properly light the area. The Contractor shall comply with any directions and public authorities in this respect.
- 7.20 The Contractor shall designate a responsible officer or employee as safety inspector, whose duties shall include accident prevention on the Project as well as implementation of the Contractor's safety measures and safety programs on the Project. The name of the safety inspector shall be made known to the Designer and the Owner at the pre-construction conference.
- 7.21 In emergencies affecting the safety of persons, the Work, or property at the Project site or adjacent thereto, the Contractor is obligated to act in the Contractor's discretion to prevent threatened damage, injury, or loss. As soon as practicable, the Contractor shall notify the Designer and Owner of such emergency. The Contractor shall give the Designer and the Owner prompt written notice of any significant changes in the Work or deviations from the Contract Documents caused by such emergency. If the Contractor believes that additional work done in an emergency entitles the Contractor to an increase in the Contract Price or an extension of the Contract Time, the Contractor may make a claim therefore as provided in Articles 14 and/or 15.
- 7.22 The Contractor shall at all times keep the premises free from accumulation of waste materials or rubbish caused by the Work. At least weekly and at the completion of the Work, the Contractor shall remove all waste materials and rubbish from and about the Project. At the completion of the Work, the Contractor shall remove all tools, construction equipment, machinery, and surplus materials. The Contractor shall leave the Work in condition for occupancy by the Owner such that no cleaning or other operations are required. Material cleared from the Project and deposited on adjacent property shall not be considered as having been disposed of satisfactorily. If the Contractor fails to keep the Project clean of waste materials or rubbish, fails to satisfactorily clean-up weekly or at the completion of the Work, the Owner may do so and the costs thereof may be deducted from any amounts due the Contractor.
- 7.23 Utilities, temporary facilities, and signs shall be provided as described in the Contract Documents. Absent a contrary direction in the Supplementary Conditions, the Contractor shall pay all bills for water, electricity, or other public utility service to the Project site.



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- 7.24 The Contractor shall indemnify and hold the Owner, the Designer, the Designer's consultants, and their officers, agents, and employees harmless against all costs, damages, and expenses, including attorney's fees and costs of defense, arising out of claims by any separate contractor or by any Subcontractor, sub-subcontractor, or supplier engaged by or employed by the Contractor or employed by any of the Subcontractors claiming through him, including without limitation damages, losses, and expenses arising out of or relating to any inconvenience, delay, interference, or other action or non-action of the Contractor or the Contractor's Subcontractors on the Project.

The Contractor acknowledges that should the Contractor or any of the Contractor's Subcontractors be damaged by any breach of contract by any other separate prime contractor on the Project, the Contractor may invoke applicable dispute resolution procedures with said other separate prime contractor or bring a direct civil action against said other separate prime contractor. The Contractor hereby expressly agrees that neither the Owner nor its officers, agents, or employees shall have any liability of any kind or nature whatsoever to the Contractor, its Subcontractors, sub-subcontractors, or suppliers arising out of or relating to any breach, inconvenience, delay, interference, or other action or non-action by any other separate prime contractor. The Contractor covenants not to sue the Owner for any loss or damage caused by any breach, inconvenience, delay, interference, or other action or non-action by any other separate prime contractor, notwithstanding whatever rights at law the Contractor might have to bring a civil action against the Owner for any breach, inconvenience, delay, interference, or other action or non-action of any other separate prime contractor. The Contractor agrees to look exclusively to the other prime contractor for relief or remedy.

Nothing contained herein or appearing anywhere in the Contract Documents shall obligate or require the Owner to exercise any right or privilege, or to take any action or to refrain from taking any action under any contract it may have with any other prime contractor or party to the Project for the benefit of the Contractor or any Subcontractor, sub-Subcontractor, or supplier claiming through the Contractor.

- 7.25 Prior to completion of the Work and Final Payment of the Contract Price, excepting only those portions of the Work deemed accepted in accordance with the Contract Documents, the Contractor shall have charge and care of the Work, and shall take every precaution against injury or damage to any part due to the action of the elements or from any other cause, whether arising from the execution or from the non-execution of the Work. The Contractor shall as required by the Owner replace, rebuild, repair, restore, and make good all injury or damage to any portion of the Work occasioned by any of the above causes before Final Completion and shall bear the expenses thereof.
- 7.26 In the event that the Work, or any portion thereof, is suspended at any time pursuant to an order of the Owner, the Contractor shall obey all instructions of the Owner regarding storage of materials, drainage, protection of the Work, and erection of temporary structures during the suspension period.
- 7.27 The Project Expediter for the Project shall be responsible for the coordination of the Work of itself and any other separate contractors, both as to space and time. The Project Expediter shall coordinate the implementation of the Contract Construction Schedule, all



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construction activities and close-out of the Project, including but not limited to all testing, inspection, certifications, and approvals required by public agencies.

The Contractor and the Project Expediter shall each be required to notify the Designer and the Owner promptly of any event or condition which could affect the conduct or progress of the Work and shall cooperate fully with all other contractors on the Project site.

- 7.28 The Owner hereby delegates to the Project Expediter all of its duties to coordinate and to expedite the Work not expressly reserved to the Owner by other provisions of the Contract Documents.
- 7.29 All Work performed pursuant to the Contract Documents shall conform in all respects to the North Carolina State Building Code and all other state, local, and national codes in effect at the time of and applicable to this Work.
- 7.30 The Contractor shall provide for and maintain necessary safety measures and safety programs for the protection of all persons at the Project site, and shall comply at all times with the requirements of the most current edition of the CAGC Safety and Health Manual [or the AGC Accident Prevention Manual in Construction], or the equivalent requirements of the Contractor's safety program, and shall fully comply with all Federal, State, and local laws, rules, regulations, and building code requirements so as to prevent accidents or injuries to persons on or about the Project site. The Contractor shall clearly mark or post signs warning of existing hazards, and shall barricade excavations, elevator shafts, stairways, and similar hazards. The Contractor shall protect against damage or injury resulting from falling materials, and shall maintain all protective devices and signs throughout the progress of the Work.
- 7.31 The Contractor shall adhere to the rules, regulations, and interpretations of the North Carolina Department of Labor's Occupational Safety and Health Standards for the Construction Industry (29 CFR Part 1926 as adopted in 13 NCAC 07F.0201, including 29 CFR Part 1910 General Industry Safety and Health Standards applicable to construction) and N.C. Gen. Stat. §95-126 through 155 (Occupational Safety and Health) as well as all revisions and amendments to such standards or statutes as may occur throughout the performance of the Work.
- 7.32 Any land disturbing activity performed by the 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 NCAC 4A, 4B, and 4C), and as may be revised or amended in the future. Upon receipt of notice that a land-disturbing activity is in violation of said Act, the Contractor shall be responsible for ensuring that all steps or actions necessary to bring the Project in compliance with said Act are promptly taken. The Contractor shall be responsible for all penalties assessed pursuant to N.C. Gen. Stat. 113A-64 with respect to its Work, and shall indemnify and hold harmless the Owner from all costs and expenses, including attorney's fees and costs of defense arising out of or related to the enforcement of the Act against any party or person described in this Article.



GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

- 7.33 Any mechanical or electrical work such as sleeves, inserts, chases, etc. located in the Work of the Contractor for general work shall be built in by that Contractor. On multiple prime projects, the mechanical and electrical contractors shall set all sleeves, inserts, and other devices built into the structure in cooperation and under the supervision of the Contractor for general work. The responsibility for exact location of such items shall be that of the mechanical, plumbing, or electrical prime contractor.
- 7.34 The Contractor shall be responsible for permanently fixed service facilities and systems in use during progress of the Work and shall strictly adhere to the following procedures:
- a) Prior to acceptance of the Work by the Owner, the Contractor shall remove and replace any part of the permanent building systems damaged through use during construction.
 - b) Temporary filters shall be installed in each of the heating and air conditioning units, return air grilles, and other locations to prevent intrusion of dust, dirt, and debris during construction. Temporary filters shall be removed and replaced with new filters immediately prior to Substantial Completion.
 - c) Extra effort shall be maintained to keep the building clean and under no circumstances shall air systems be operated if finishing operations are creating dust in excess of what would be considered normal if the building were occupied.
 - d) When the permanent lighting system is used during construction, lamps shall be replaced and shall be new on the date of Substantial Completion.

ARTICLE 8. OWNER

- 8.1 The Owner shall issue communications and notices to the Contractor through the Designer to the extent contemplated by the Contract Documents.
- 8.2 In case of termination of the employment of the Designer, the Owner shall appoint as Designer a qualified person who shall have and assume all rights and duties held by the original Designer.
- 8.3 The Owner shall have the right to take possession of and use any portion of the Work notwithstanding the fact that the time for completion of such portion of the Work may not have expired, but such taking possession and use shall not be deemed an acceptance of any Work not completed in accordance with the Contract Documents.
- 8.4 A waiver on the part of the Owner of any breach of any part of the Contractor shall not be held to be a waiver of any other or subsequent breach.
- 8.5 The Owner shall pay all permanent acreage fees, governmental impact fees, and meter deposits for permanent utilities.

ARTICLE 9. CONSTRUCTION MANAGER



GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

- 9.1 The Owner may employ one or more Construction Managers for the purpose of assisting the Owner, Designer, and Contractor in developing and administering budgets and cost controls, in evaluating constructability and value engineering proposals, in establishing and maintaining a critical path method (CPM) schedule, in coordinating and/or expediting the Work with other projects being constructed by the Owner or others adjacent or near the Work, or for such other purposes as the Owner may deem appropriate. From time to time the Owner may identify such Construction Managers(s) to the Contractor in writing identifying any tasks assigned to such Construction Managers(s).

ARTICLE 10. DESIGNER

- 10.1 The Designer is charged with the responsibility of interpretation of the Contract Documents. The Designer's decisions relating to aesthetic matters shall be final.
- 10.2 All Work completed under the Contract Documents shall be subject to review by the Designer. No Work is to be covered without the Designer's review or prior authorization. Any Work so covered without the Designer's review or prior authorization shall be uncovered at the Contractor's expense. The Contractor shall notify the Designer in writing at least twenty-four (24) hours in advance of covering any Work.
- 10.3 The Designer shall not be responsible for the construction means, methods, techniques, sequences, procedures, or the safety precautions and programs incident thereto, and shall not be responsible for the Contractor's failure to perform the Work in accordance with the Contract Documents, but shall be entitled to enforce any requirements in the Contract Documents specifying particular means, methods, techniques, sequences, or procedures.
- 10.4 The Designer shall be an Owner's representative during the construction period. The duties, responsibilities and authority of the Designer as the Owner's representative during construction are as set forth in the Contract Documents.

ARTICLE 11. TESTING AND SURVEYING

- 11.1 Laboratory and field tests to determine compliance of construction with the Contract Documents shall be made by the Owner or testing consultants employed by the Owner except those required elsewhere in the Contract Documents to be paid for by the Contractor. The costs and expenses of providing samples for and assistance in any testing shall be borne by the Contractor and are included in the Contract Price. Any Work in which untested materials are used without approval or written permission of the Designer shall be removed and replaced at the Contractor's expense. Work found to be unacceptable or unauthorized will not be paid for and, if directed by the Designer shall be removed and replaced at the Contractor's expense. Unless otherwise designated, tests in accordance with the cited standard methods of ASTM or other generally recognized or specifically authorized methods which are current on the date of advertisement for bids shall be made at the expense of the Owner; provided, however, in the event that after such testing any Work is found to be defective or does not meet the requirements of the Contract Documents, the costs of retesting such Work and the costs of inspection services shall be paid by the Contractor. Samples shall be taken by a testing laboratory employed by the Owner. All materials being used are subject to inspection, tests, or rejection at any time prior to or during incorporation into the Work. Copies of all Owner test reports will be



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furnished to the Contractor at his written request. Copies of Contractor test reports shall be furnished to the Designer upon written request.

11.2 The Owner shall have the right to deduct the costs of additional testing as described in paragraph 11.1 from any money due the Contractor; or if no money is due the Contractor, the Owner shall have the right to recover these costs from the Contractor, from its sureties, or from both.

11.3 All layouts and surveying shall be accomplished by properly qualified personnel duly licensed in the State of North Carolina.

ARTICLE 12. SEPARATE CONTRACTS

12.1 It is expressly understood that the Owner may deploy the Owner's own employees or engage other separate prime contractors to perform Work as a part of the Project whose work will be performed simultaneously and sequentially with the performance of the Work by the Contractor. It shall be necessary for the Contractor to coordinate construction activities with such other contractors, particularly with respect to access to work areas, storage of materials, and use of elevators and other common facilities. The Contractor shall diligently and in good faith cooperate with the Owner, the Designer, and all other contractors with respect to such matters and shall regularly and faithfully attend any and all meetings called by the Owner or the Designer with respect to such matters. Any disputes between the Contractor and any other separate prime contractor with respect to such matters shall be resolved in accordance with the claim and dispute resolution procedures in the Agreement.

ARTICLE 13. CONTRACT TIME

13.1 Within fourteen (14) days after receipt of the Construction Agreement by the Contractor for signatures, the Project Expediter shall prepare and submit to the Designer and Owner for review and approval a preliminary progress schedule for the Work pursuant to the requirements stated in the Contract Documents.

13.2 Within fourteen (14) days after initial receipt of the Construction Agreement for signatures the Contractor shall submit to the Designer a Submittal Register listing all Submittals the Contractor is required to make or proposes to make under the Contract Documents, the dates on which the Contractor proposes to make such Submittals and the dates by which the Contractor reasonably requires a response from the Designer with respect to each Submittal. The dates submitted shall be incorporated into the Contract Construction Schedule as Completion Dates when they have been approved or modified by the Owner. The Designer shall not be required to review any Submittal from the Contractor until a Submittal Register acceptable to and approved by the Owner has been submitted by the Contractor.

13.3 Not later than thirty (30) days following execution and delivery of the Construction Agreement by Owner to Contractor, the Owner shall deliver to the Contractor a Notice to Proceed. The Notice to Proceed shall state a commencement date on which it is expected that the Contractor will begin the Work to be performed under the Agreement. The Contract Time shall be measured from said specified commencement date. The commencement



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date stated in the Notice to Proceed shall not be earlier than three (3) days after the Notice to Proceed is served on the Contractor.

If, other than by mutual agreement, said specified commencement date is more than thirty (30) days after the date of execution and delivery of the Agreement from Owner to Contractor and the Contractor believes said delay justifies an increase in Contract Price and/or an extension of Contract Time, the Contractor may make a claim therefore as provided in Article 14 and/or Article 15.

No Work shall be done prior to the date specified in the Notice to Proceed.

A final Contract Construction Schedule shall be submitted for approval by the Contractor, Designer, and Owner no later than fourteen (14) days after Notice to Proceed. No payments shall be due the Contractor until this schedule is approved by all parties.

- 13.4 The Contract Construction Schedule is a Contract Document. The Contractor represents that the Contract Construction Schedule has been reviewed in detail, that the Contractor participated in its preparation, that all of the activities which impact, limit, or otherwise affect the time of completion of the Work are shown in the Contract Construction Schedule and that all of the activities of others which impact, limit, or otherwise affect the start, duration, or completion of the Contractor's activities are also shown. The Contractor further represents that the Contractor can and will complete each activity within the time shown for that activity. Time is of the essence with respect to each such activity and Completion Date.
- 13.5 If the Contractor submits a construction schedule, progress report, or any other document that indicates or otherwise expresses an intention to achieve completion of the Work prior to any Completion Date required by the Contract Documents or prior to expiration of the Contract Time, no liability of the Owner to the Contractor for any failure of the Contractor to so complete the Work shall be created or implied.
- 13.6 If the Contractor, for reasons beyond the Contractor's control, is delayed in beginning any activity, the Contractor shall, nevertheless, have the same number of days as is shown in the Contract Construction Schedule for the activity, and the affected activity and any succeeding activity that is dependent upon that activity shall be adjusted accordingly; provided that at any time the Owner, by means of a Change Order, may require the Contractor to work overtime, to increase labor forces or to take any necessary or appropriate action to decrease the time required for any activity, and the Contractor shall be entitled to an adjustment in the Contract Price computed in accordance with Article 15 of these General Conditions.
- 13.7 At any time, the Owner may order the Contractor, on seven (7) days written notice, to begin any activity earlier than the starting date shown on the Contract Construction Schedule.
- 13.8 Should the Contractor fail to start any activity on the start date shown in the Contract Construction Schedule or as it may have been adjusted in accordance with paragraphs 13.5 or 13.6 above, or become delayed, the Contractor shall, without being entitled to any increase in the Contract Price or other compensation, work overtime, increase labor forces or take such other action as may be necessary or appropriate to complete the activity by



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the Completion Date shown on the Contract Construction Schedule, or as such Completion Date may have been adjusted.

- 13.9 The Designer and Owner or his Construction Consultant shall monitor progress of the Work at all times and the Contractor shall cooperate with such monitoring and provide any and all information with respect to the progress of the Work and scheduling as the Owner may reasonably require.
- 13.10 On a monthly basis, the Contractor shall revise the Contract Construction Schedule, showing any adjustments made in accordance with paragraphs 13.5 or 13.6, above, by any Change Order, the progress of the Work, and any days gained or days lost with respect to any activity, and shall furnish copies thereof to the Owner and Designer.
- 13.11 Should any monthly revision of any Contract Construction Schedule show that the Contractor is behind on any activity, the late completion of which could delay Substantial Completion of the Work, the Owner shall be entitled to withhold from the next Progress Payment due the Contractor an amount not exceeding the amount the Owner would be entitled to in Liquidated Damages, should Substantial Completion be delayed by the same number of days that the Contractor is currently behind schedule. If, subsequently, the Contractor's progress, as shown by any succeeding monthly revision to the Contract Construction Schedule, is such that the anticipated delay no longer exists, the Owner shall pay with the Progress Payment next due to the Contractor such amounts as have been withheld in accordance with this paragraph.
- 13.12 The Owner shall have the right to perform Work, hire and employ labor and craftsmen, rent equipment, subcontract with other parties, or do anything that the Owner deems necessary or appropriate to remedy or cure any delay by the Contractor in the progress of the Work. Such action by the Owner shall not, in any way, affect, void or limit any warranty, guaranty or other responsibility of the Contractor under the Contract Documents. Such action may be taken by the Owner only after three (3) days written notice to the Contractor. All costs incurred by the Owner in taking any such action shall be charged to the Contractor and deducted from any amounts remaining due under the Agreement.
- 13.13 The Contractor may be entitled to an extension of the Contract Time (but no increase in the Contract Sum) for delays arising from unforeseen causes beyond the control and without the fault or negligence of the Owner, the Contractor or the Contractor's Subcontractors as follows:
- a) Labor disputes and strikes that directly impact the critical path activities of the Contract Construction Schedule;
 - b) Acts of God, tornado, fire, hurricane, blizzard, earthquake, typhoon, or flood that damage completed Work or stored materials.
 - c) Acts of the public enemy; acts of the State, Federal, or local government in their sovereign capacities.
 - d) Abnormal inclement weather as defined in Article 13.14.



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- 13.14 On any day that the Contractor considers that the Project is delayed by adverse weather conditions, the Contractor shall identify in writing to the Designer and the Owner the adverse weather conditions affecting each activity, the specific nature of the activity affected, the number of hours lost, and the number of and identity (by responsibility or trade) of workers affected and shall obtain from the Designer written recognition of the delay. The time for performance of this Contract includes an allowance for a number of calendar days which may not be suitable for construction Work by reason of adverse weather. The Contract Time will be extended only if the number of calendar days of adverse weather recognized by the Designer exceeds the number of inclement weather days set forth below, and the Contractor demonstrates how this adverse weather impacts activities on the critical path of the Contract Construction Schedule.

<u>Month</u>	<u>Number of Inclement Weather Days</u>
January	10
February	10
March	10
April	9
May	10
June	9
July	11
August	10
September	8
October	7
November	8
December	9

- 13.15 If the Contractor believes that the progress of the Work has been adversely affected by adverse weather recognized by the Designer during a particular month, the Contractor shall submit a written request for extension of time to the Designer. Such a request for time extension of the Contract Time shall be submitted by the tenth (10th) day of the month following that month in which the adverse weather is encountered. The request shall include, but is not limited to, the following information:

- a) Detailed description of weather's effect on scheduled activities and its net effect on the critical path of the Project, and
- b) Weather records from the official weather station nearest the Project site and records of actual observation as contained in daily reports, correspondence, or other documentation.

- 13.16 The Contractor specifically recognizes that a delay by the Contractor in achieving any Completion Date can have the effect of delaying the Substantial Completion of the Project, that such delay in Substantial Completion of the Project will necessarily cause damages, losses, and expenses to the Owner, including, but not limited to and by way of illustration only, increased capitalized costs and interests for the Project, increased and extended Project overhead, Designer's and Consultant's fees, increased costs of construction, increased and extended operation costs of other facilities, and inefficiency and loss of productivity, and that such damages, losses, and expenses may not be readily identifiable or ascertainable at the time they are incurred or at any time. Therefore, and in recognition



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of these factors and the likelihood that actual damages from his delay will not be readily ascertainable, the Contractor agrees to pay to the Owner, as Liquidated Damages and not as a penalty, the sum identified in the Supplemental Conditions hereto as the Liquidated Damages per Day, for each day by which the failure to meet any Completion Date shown in the Contract Construction Schedule, adjusted in accordance with this Article, delays the Substantial Completion of the Project.

- 13.17 The Contractor shall not be entitled to any adjustment in the Contract Price or other compensation from the Owner for any delay in the completion of or progress on the Work that is caused by a force majeure condition or is otherwise not caused by the sole and direct act or omission of the Owner and the Owner's employees or agents.
- 13.18 The sum for Liquidated Damages is the amount stipulated in the Supplementary General Conditions per day per Prime Contractor as Liquidated Damages reasonably estimated in advance to cover the losses to be incurred by the Owner by reason of failure of said Contractor(s) to complete the Work within the time specified, such time being in the essence of this contract and a material consideration thereof.

ARTICLE 14. CHANGES IN THE WORK

- 14.1 Without invalidating the Contract Documents, the Owner may, at any time, or from time to time order additions, deletions, or revisions in the Work. Said additions, deletions, or revisions shall be authorized only by written Change Orders, Construction Change Directives or Field Orders. Upon receipt of a Change Order, Construction Change Directive or Field Order, the Contractor shall proceed with the Work involved. All such Work shall be executed under the applicable conditions of the Contract Documents. If any change causes an increase or decrease in the Contract Price and/or an extension or shortening of the Contract Time, adjustments shall be made as provided in Article 14 and/or Article 15.

In order to expedite the Work and avoid or minimize delay in the Work that might affect the Contract Price or Contract Time, the Designer may issue a Change Order in the form of a Construction Change Directive which when signed by the Owner and Designer, directs the Contractor to proceed promptly with the Work involved. Any claim for an adjustment in Contract Price or Time, if not defined in the Construction Change Directive, shall be promptly made in writing in accordance with the procedures defined in Article 15.2.

- 14.2 The Designer may authorize minor changes or alterations in the Work not involving change in the Contract Price or in the Contract Time and not inconsistent with the overall intent of the Contract Documents. These may be accomplished by a Field Order. Such alterations shall not invalidate the Contract Documents nor release the surety. If the Contractor believes that any minor change or alteration authorized by the Designer entitles him to an increase in the Contract Price and/or an extension of Contract Time, he may make a claim therefore as provided in Article 14 and/or Article 15.
- 14.3 Except in an emergency endangering life or property, no change shall be made by the Contractor except upon prior written Change Order, Directive or Field Order authorizing such Change.



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- 14.4 Increases in the Contract Price and/or extensions of the Contract Time for additional Work performed by the Contractor shall only be in accordance with a written Change Order signed by the Owner and Designer. The Contractor shall not be entitled to additional time or to additional compensation for any Work performed or material supplied which is claimed to have been authorized or settled by an "oral" change, or by a "constructive" or "implied" change, or by a course of conduct, or by any action or non-action by the Owner, Designer, or any other persons, or by any means whatsoever other than by a written Change Order for such Work or material signed by the Owner and the Designer.
- 14.5 Changes in the Work resulting from emergency shall not invalidate the Contract Documents nor release the surety.
- 14.6 Neither the Owner nor the Designer shall be responsible for verbal instructions which have not been confirmed in writing, and in no case shall such instructions be interpreted as permitting a departure from the Contract Documents unless such instruction is confirmed in writing and supported by a proper Change Order, Construction Change Directive or Field Order, whether or not the cost is affected.
- 14.7 The Owner, in its sole discretion, may require that the Contractor notify the Contractor's sureties of any changes affecting the general scope of the Work or change in the Contract Price, and that the amount of applicable bonds shall be adjusted accordingly. If this requirement is exercised, the Contractor shall furnish proof of such adjustment to the Designer and the Owner.
- If this requirement is exercised, the Change Orders shall require written consent of the Contractor's surety. At the time of signing a Change Order, the Contractor shall be required to certify as follows:
- "I certify that all sureties have been notified that my contract has been altered by the amount of this Change Order, and that a copy of the approved Change Order will be mailed to all sureties upon its receipt by me."
- If this requirement is exercised, no payment to the Contractor on account of any Change Order shall become due or payable until written evidence of the surety's consent to the Change Order has been furnished to the Designer and to the Owner, and the furnishing of such written consent is a condition precedent to such payment.
- 14.8 The Contractor shall support all requests for Change Orders with a detailed cost breakdown showing cost of materials, labor, equipment, transportation, other items, Contractor's overhead and profit, and total cost, in accordance with methods defined in this Article, and, if the request seeks an extension of the Contract Time, with a time-related diagram which demonstrates specifically why an increase in construction time is needed.
- 14.9 When a request for a Change Order involves a Subcontractor, the Contractor shall provide quotation from same on Subcontractor's letterhead. The Subcontractor's quote shall list materials, equipment, and labor separately, and show overhead and profit in the manner provided in paragraph 14.8.

ARTICLE 15. CHANGE OF THE CONTRACT PRICE



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15.1 The Contract Price constitutes the total compensation payable to the Contractor for performing all Work under the Contract Documents. All duties, responsibilities, and obligations assigned to or undertaken by the Contractor shall be at his expense without change in the Contract Price. The Contract Price may only be changed by a Change Order.

15.2 Any claim for an adjustment in the Contract Price shall be in writing and written notice of any event, action, or non-action which may become the basis of a claim shall be delivered to the Owner and the Designer within three (3) days of the occurrence, or the beginning of the occurrence, of any such event, action or non-action giving rise to the claim. Such written notice is a condition precedent to the making of a claim, and such notice shall describe the basis of the potential claim with reasonable detail and clarity.

A claim shall be made in writing and shall be delivered to the Designer and the Owner no later than fourteen (14) days after such notice. The claim shall describe in detail the basis for the claim, with specific reference to any provisions of the Contract Documents, by paragraph, drawing number, or other specific identification, and shall state the amount claimed and how it is calculated. If the Contractor, at the time the claim is made, is unable to state the amount claimed with accuracy, the Contractor shall so state and provide the estimated amount and the basis on which the amount is to be calculated. At the earliest date practicable, but in no event more than thirty (30) days after Contractor's notice of claim, the Contractor shall supplement the claim with an accurate statement of the amount claimed and how it has been calculated. The Contractor shall provide, in writing, in support of the claim all such explanations, arguments, data, receipts, expert opinions, or other documents or information as the Contractor deems appropriate to be considered in support of the claim. A claim may properly be rejected by the Owner by reason of the Contractor's failure to submit adequate or accurate documentation or information, except that within seven (7) days after being given notice that the claim has been rejected on this basis, the Contractor may submit additional documentation or information. No claim for a change of the Contract Price shall be considered or granted (except solely at the discretion of the Owner) unless a claim is so made, nor shall the Contractor be entitled to any increase in the Contract Price unless the Contractor has given notice and made such a written claim within the times required. The Owner shall decide, after obtaining the advice of the Designer, whether an increase in Contract Price is warranted, and the amount of such increase shall be determined as provided in paragraph 15.4 through 15.5, below. Any change in the Contract Price resulting from any such claim shall be incorporated in a Change Order.

The Owner shall advise the Contractor of its decision with respect to the claim within fourteen (14) days of its receipt, or of the receipt of additional documentation or information if the absence of such has previously been the basis of rejection of the claim; provided, however, that if, in its sole discretion, the Owner deems that review or consideration of any part of the claim or any matter related thereto by its governing Board is necessary or appropriate, it shall so advise the Contractor and shall provide its decision to the Contractor within seven (7) days after such Board consideration, review or action. Any claim on which the Owner has not provided its decision to the Contractor within the applicable time period shall be deemed denied.



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If the Contractor is not satisfied with the decision of the Owner, the Contractor may within seven (7) days of receipt of the Owner's decision initiate the mediation process as described in Appendix A to the General Conditions of the Contract for Construction.

- 15.3 In determining the amount of a Contract Price adjustment, the parties shall apply the following methods, as appropriate:

(A) Change in Work: The Owner and Contractor shall negotiate in good faith and attempt to agree upon the value of any change (extra or decrease) in Work prior to the issuance of a Change Order covering said Work. Such Change Order shall set forth the corresponding adjustment to the Contract Price. In the event the Owner and the Contractor are unable to agree, the Owner shall grant an equitable adjustment in the Contract Price.

(B) Emergency Work: In the event of emergency endangering life or property, the Contractor may be directed by the Designer to proceed on a time and material basis, whereupon the Contractor shall so proceed and keep accurately, in such form as may be required by the Designer, a correct account of costs together with all proper invoices, payrolls, and supporting data therefore.

- 15.4 Where the Contract Price is to be adjusted, the following limitations shall apply in determining the amount of adjustment:

(A) In the case of extra or emergency work, the Contract Price shall not be increased by more than the reasonable, actual, and documented net cost of the extra or emergency work plus ten percent (10%) of such net cost on Work performed by the Contractor and five percent (5%) thereof on any subcontracted Work for overhead and profit combined.

(B) In the case of a decrease in Work, the Contract Price shall not be decreased by less than the net cost of the deleted Work plus five percent (5%) of such direct net cost for profit and overhead.

The term 'net cost' as used herein shall include, as applicable, and shall be limited to, all direct labor, direct material, direct equipment, labor burden, sales taxes, shipping and handling charges, permits and fees, and insurance and bond premium adjustments, if any, attributable to the change. All other items of cost shall be considered as overhead and covered by the percentages allowed in sections A and B of this paragraph.

The Contractor shall provide worksheets or tabulations describing the method by which the direct net cost was calculated, and shall provide all data needed to support the calculation of the direct net cost, all in a form acceptable to the Owner.

- 15.5 Where the Contract Price is to be adjusted by negotiation, the Owner may authorize and designate the Designer to negotiate with the Contractor on behalf of the Owner; provided, however, any agreement reached between the Contractor and Designer shall be subject to approval by the Owner.



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ARTICLE 16. UNFORESEEN CONDITIONS

- 16.1 Should the Contractor encounter unforeseen conditions at the Project site materially differing from those shown on the Drawings or indicated in the Specifications or differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in this Agreement, the Contractor shall immediately, and in no event more than three days later, give notice to the Owner of such conditions before they are disturbed. The Owner and the Designer shall thereupon promptly investigate the conditions and if they find that they materially differ from those shown on the Drawings or indicated in the Specifications, they shall at once make such changes in the Drawings and/or Specifications as they may find necessary. Any increase or decrease in the Contract Price resulting from such changes shall be adjusted in the manner provided herein for adjustments as to extra and/or additional Work and changes. However, neither the Owner nor the Designer shall be liable or responsible for additional work, costs, or changes to the Work that could have been reasonably determined from any reports, surveys, and analyses made available for the Contractor's review or that could have been discovered by the Contractor through the performance of its obligations pursuant to the Contract Documents.

ARTICLE 17. CORRECTION OF WORK BEFORE FINAL PAYMENT

- 17.1 The Owner has the authority to stop or suspend work, and the Designer has the authority to order Work removed or to order corrections of defective Work or Work not in compliance with the Contract Documents where such action may be necessary to ensure successful completion of the Work.

Any work, materials, fabricated items, or other parts of the Work which have been found by the Designer to be defective or not in accordance with the Contract Documents shall be condemned and shall be removed from the Project by the Contractor, and immediately replaced by new Work in accordance with the Contract Documents at no additional cost to the Owner. Work or property of the Owner or others damaged or destroyed by virtue of such condemned Work shall be made good at the expense of the Contractor.

Correction of condemned Work described above shall be commenced by the Contractor within twenty-four (24) hours after notice from the Designer or the Owner and shall be pursued to completion. Should the Contractor fail to proceed reasonably with the above-mentioned corrections, the Owner may, three (3) days after the notice specified in the preceding sentence, proceed with correction, paying the cost, including costs of uncovering such condemned Work, of such corrections from amounts due or to become due to the Contractor.

Condemned Work removed shall be the property of the Contractor and shall be removed from the Project by him within ten (10) days after notice to remove it, and if not then removed, thereafter may be disposed of by the Owner without compensation to the Contractor and the cost of such disposal shall be deducted from amounts due or to become due to the Contractor.



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Should the cost of correction of the Work and, if applicable, disposal of the condemned Work by the Owner exceed amounts due or to become due the Contractor, then the Contractor and the Contractor's sureties shall be liable for and shall pay to the Owner the amount of such excess.

ARTICLE 18. CORRECTION OF WORK AFTER SUBSTANTIAL COMPLETION; WARRANTIES AND GUARANTIES

18.1 Neither the final certificate, Final Payment, occupation of the premises by the Owner, nor any provision of the Contract Documents, nor any other act or instrument of the Owner or the Designer shall relieve the Contractor from responsibility for negligence, defective material or workmanship, or failure to comply with the Contract Documents.

18.2 The Contractor shall, at the Contractor's sole cost and expense, make all necessary repairs, replacements, and corrections of any nature or description, interior or exterior, structural or non-structural, that shall become necessary by reason of defective workmanship or materials which appear within a period of one (1) year from the date of Substantial Completion; provided, however that notwithstanding the preceding, if any longer guarantee period is specified for any particular materials or workmanship under the Contract Documents, or under any subcontract, or in connection with any manufactured unit which is installed in the Project, or under the laws of the State of North Carolina, the longer guarantee period shall govern.

18.3 If, within any guarantee period, repairs or changes are required in connection with the Work, which are rendered necessary as the result of the use of materials, equipment, or workmanship which are inferior, defective, or not in accordance with the terms of the Contract Documents, the Contractor shall, promptly upon receipt of notice from the Designer and without expense to the Owner:

- a) Completely repair or replace the Work so that it conforms to the Contract Documents;
- b) Correct all defects therein;
- c) Make good all damage which, in the opinion of the Designer, is the result of the use of materials, equipment, or workmanship which are inferior, defective, or not in accordance with the terms of the Contract Documents; and
- d) Make good any Work or material, or any equipment or contents disturbed in fulfilling any such guarantee.

If, in fulfilling the requirements of the Contract Documents or of any guarantee embraced therein or required thereby, the Contractor disturbs any work, facility, premises, or construction belonging to the Owner, the Contractor shall restore such disturbed work to a condition satisfactory to the Owner, and shall guarantee such restored work to the same extent as if it were Work under the Contract Documents.

If the Contractor, after notice, fails to proceed promptly to comply with the terms of the guarantee, the Owner may have the defects corrected, and the Contractor and the



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Contractor's sureties shall be liable for all expenses incurred. "Promptly" is defined as within twenty-four (24) hours for systems necessary to normal operation of the building and within seventy-two (72) hours for all other items. All special guarantees applicable to definite parts of the Work that may be shown in or required by Contract Documents shall be subject to the terms of this paragraph during the first year of the life of such special guarantee. Manufacturer's standard guarantees or warranties which do not comply with the time limit specified herein shall be extended by the Contractor automatically without further action on the part of the Owner or the Designer.

- 18.4 In the eleventh calendar month after the date of Substantial Completion, and at the request of the Owner, the Contractor, the Owner and the Designer shall make an inspection of the Work for the purpose of identifying defective workmanship and/or materials. If the Contractor, having been requested to do so by the Owner, fails to participate in such inspection, the Contractor shall be conclusively bound by any decision or ruling by the Designer as to any defective workmanship or material and as to the Contractor's responsibility for its repair or replacement.

ARTICLE 19. OWNER'S RIGHT TO DO WORK

- 19.1 If, during the progress of the Work or during any period of guarantee, the Contractor fails to prosecute the Work properly or to perform any provision of the Contract Documents, the Owner, after three (3) days written notice to the Contractor from the Designer, or from the Owner after Final Payment, may perform or have performed that portion of the Work and may deduct the cost thereof from any amounts due or to become due the Contractor. Notwithstanding any action by the Owner under this paragraph, all warranties and bonds given or to be given by the Contractor shall remain in effect or shall be given by the Contractor.
- 19.2 Should the cost of such action by the Owner exceed the amount due or to become due the Contractor, the Contractor and his sureties shall be liable for and shall pay to the Owner the amount of such excess.

ARTICLE 20. PARTIAL PAYMENTS

- 20.1 Within thirty (30) days after his initial receipt of the Construction Agreement for signatures, the Contractor shall submit to the Designer a Schedule of Values. The Schedule of Values shall indicate the value of the Work, including applicable overhead and profit, for each Division and section of the Project Specifications. The Designer and Owner shall be provided with the Contractor's estimate papers, Subcontractor agreements, supplier quotes, or other documents substantiating these values if so requested in writing by the Designer. The Contractor shall provide the requested documentation within seven (7) days after receipt of the Designer's written request. The Schedule of Values shall be subject to approval by the Owner, and if the Owner and the Contractor cannot agree upon the Schedule of Values, the Designer shall prepare it, and the Schedule of Values as prepared by the Designer shall be binding on the Owner and the Contractor. No Request for Payment shall be certified by the Designer until the Designer has issued approval of said Schedule of Values.



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20.2 Not later than the fifth (5th) day of each calendar month the Contractor shall submit to the Designer a Request for Payment for Work done during the previous calendar month. The Request for Payment shall be in form of AIA Document G702 (latest edition) and shall show substantially the value of Work done (including the value of material delivered to the Project or stored by the Contractor at another site, subject to the conditions hereinafter set forth) during the previous calendar month, and shall sum up the financial status of the Work with the following information:

- a) Total Contract Price, including any adjustment thereto made pursuant to the Contract Documents.
- b) Value of Work completed and materials properly stored to date.
- c) Less amount retained.
- d) Less previous payments.
- e) Current amount due.
- f) Balance remaining.

The Contractor, upon request of the Designer, shall substantiate the request with invoices, vouchers, payrolls, or other evidence.

20.3 When payment is requested or made on an account of stored materials, such materials must be stored on the Owner's property at such places and in such a manner as may be designated by the Designer. However, in the sole discretion of the Owner, with permission in writing from the Designer and Owner and under such circumstances as may be determined by the Owner, such materials may be stored in a bonded warehouse. The location and conditions for storage of such materials away from the Owner's property in a bonded warehouse shall be within the sole discretion of the Owner. Requests for Payment on account of stored materials shall be accompanied by paid invoices, bills of sale, warehouse receipts, or other documentary evidence establishing Owner's title to such materials, evidence that the stored materials are insured against loss and damage, and such other documentation as required by the Designer. Responsibility for the quantity, quality, and condition of such stored materials, whether stored on the Owner's property or away from the Owner's property, shall remain with the Contractor regardless of ownership or title. No payment shall be made on account of materials stored in a bonded warehouse unless the Contractor has acquired written permission from the Designer for such storage of materials and has complied with all conditions set forth in such permission regarding such storage of materials in a bonded warehouse.

20.4 Any Request for Payment received by the Designer on or before the fifth (5th) of the calendar month shall be certified for payment or returned for re-submission to the Contractor on or before the fifteenth (15th) of the calendar month. The Designer's certification shall be for the amount which was requested or that which the Designer has decided was justly due, and shall state in writing to the Contractor and Owner the reasons for withholding payment of any or all of the amount requested.



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- 20.5 The Designer may fail to certify all or part of any payment requested for any of the following reasons:
- a) Defective Work not corrected.
 - b) Suits, actions, or claims of any character filed against the Contractor, or due to the operations of the Contractor, or information or notice that a suit, action, or claim will be filed or has been made.
 - c) Information or notice that a Subcontractor or a supplier has not received payment.
 - d) The balance unpaid of the Contract Price is insufficient to complete the Work in the judgment of the Designer or Owner.
 - e) Damage to the Owner or another contractor.
 - f) Inability of the Contractor to meet a Completion Date, including an anticipated failure to meet a Completion Date entitling the Owner to withhold anticipated Liquidated Damages in accordance with paragraphs 13.16 and 13.18 hereof.
 - g) Failure to furnish Submittal as required by the Contract Documents on a timely basis in accordance with the Submittal Register.
 - h) Such other reason as to the Designer may appear prudent, proper, or equitable.

When grounds for withholding certification have been corrected, the Designer shall so certify to the Owner and the Owner shall make any payment due with respect to such certification as a part of his next payment after such certification.

- 20.6 No certificate issued or progress payment made shall constitute an acceptance of the Work or any part thereof.
- 20.7 The amount certified by the Designer for payment shall be ninety-five percent (95%) of the value of Work completed and materials stored since the Designer's last certification as shown on the Request for Payment, less any amounts not certified in accordance with paragraph 20.4, and this amount shall be paid by the Owner on or before the last business day of the month, but payment shall not be past due until not paid within fifteen (15) days thereafter.
- 20.8 After certification by the Designer that the Work is fifty percent (50%) complete, based on a determination that the Contractor's gross project invoices, excluding the value of materials stored off-site, equal or exceed fifty percent (50%) of the value of the Contract, (except the value of materials stored on-site shall not exceed twenty percent (20%) of the Contractor's gross project invoices for the purpose of determining whether the Project is fifty percent (50%) complete) and the Contractor has provided to the Owner the written consent of its sureties to the cessation of further percentage retention, the amount certified for payment with respect to subsequent Requests for Payment shall be one hundred percent (100%) of the value of Work completed and materials stored since the Designer's last certification as shown on the Request for Payment, less any amounts not certified in accordance with



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paragraphs 20.4 and 20.5; provided, however, that the aggregate of periodic payments shall not exceed ninety-seven and one half percent (97.5%) of the Contract Price. If the Owner determines that the Contractor's performance under the Contract is unsatisfactory, the Owner may resume withholding percentage retention from each subsequent periodic payment application up to the maximum amount of five percent (5%) of the Contract Price.

ARTICLE 21. FINAL PAYMENT

- 21.1 If the Work of the Contractor is limited to demolition, pilings, caissons and/or structural steel, the remaining unpaid balance of the Contractor's Contract Price, less a sum equal to five-tenths percent (0.5%) of the Contract Price, shall be paid within sixty days following receipt of the following documents, all of which must be received before payment shall become due: (i) request for payment from the Contractor; (ii) receipt of consent from the Contractor's surety to the payment; and (iii) approval or certification from the Designer that the work performed by the Contractor is acceptable and in accordance with the Contract Documents.
- 21.2 Except as set forth in paragraph 21.1, within forty five days after Substantial Completion of the Project, the remaining unpaid balance of the Contract Price shall be paid to the Contractor, less an amount equal to two and one-half times the value of punch list work or other work remaining to be completed or corrected, as reasonably estimated by the Owner.
- 21.3 Upon Substantial Completion, the Designer shall prepare and submit to the Contractor a deficiency list identifying all portions of the Work which are known by the Designer at that time to be incomplete or defective. Within thirty (30) days of receipt of this deficiency list, the Contractor shall complete and correct all items on that list along with all other Work required to achieve Final Completion of the Work. At any time prior to completion of the period of warranty, the Designer may submit to the Contractor a supplemental deficiency list, in which case the Contractor shall complete or correct any and all new items identified on the Supplemental deficiency list within the time period stipulated in paragraph 18.3.
- 21.4 Final Payment of any remaining balance of the Contract Price shall not be due to the Contractor until the Contractor achieves Final Completion of the Project.
- 21.5 The making and acceptance of Final Payment shall constitute a waiver of all claims by the Owner except:
- a) Claims arising from unsettled liens or claims against the Contractor.
 - b) Defective Work or materials appearing after Final Payment.
 - c) Failure of the Contractor to perform the Work in accordance with the Contract Documents.
 - d) As conditioned in the Performance Bond.
 - e) Claims made prior to Final Payment which remain unsettled.
 - f) Amounts due arising under Articles 18 and 28.



GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

- g) Claims for recovery of overpayment based upon incorrect measurement, estimate, or certificate.

21.6 The making and acceptance of Final Payment shall constitute a waiver of all claims by the Contractor except those claims previously made in writing pursuant to paragraph 15.2 and not finally resolved.

21.7 The Designer shall not authorize Final Payment until all of the Work under the Contract Documents has been certified by the Designer as completed, proper and suitable for occupancy and use, and has been approved by all federal, state and local agencies having jurisdiction.

21.8 The final Request for Payment shall be identified on its face as such and shall be presented by the Contractor to the Designer within thirty (30) days of completion of the Work. Final payment of the retained amount due the Contractor shall be made by the Owner within thirty (30) days after the later of (i) full and Final Completion of all Work required by the Contract Documents, and certification of such Work in accordance with paragraph 20.4; (ii) submission of the affidavits of other documentation required by Article 22; (iii) submission by the Contractor of a Request for Payment identified on its face as final and including the Designer's certification.

ARTICLE 22. CONTRACTOR, SUBCONTRACTOR AND SUPPLIER AFFIDAVIT

22.1 The Final Payment due the Contractor on account of the Contract Documents shall not become due until the Contractor has furnished to the Owner through the Designer: (A) an affidavit by the Contractor signed, sworn, and notarized to the effect that all payments for materials, services, or for any other reason in connection with the Work or performance of the Contract Documents have been satisfied and that no claims or liens exist against the Contractor in connection with the same; (B) affidavits from each Subcontractor and supplier signed, sworn, and notarized to the effect that (i) each such Subcontractor or supplier has been paid in full by the Contractor for all Work performed and/or materials supplied by him in connection with the Project, and (ii) that all payments for materials, services, and for any other reason in connection with the subcontract or supply contract have been satisfied and that no claims or liens exist against the Subcontractor or supplier in connection therewith; and (C) the written consent of the Contractor's sureties to Final Payment. In the event that the Contractor cannot obtain an affidavit, as required above, from any Subcontractor or supplier, the Contractor shall state in the Contractor's affidavit that no claims or liens exist against such Subcontractor or supplier to the best of the Contractor's knowledge, and that if any appear afterwards, the Contractor shall save the Owner harmless for all costs and expenses, including attorneys fees, on account thereof.

ARTICLE 23. ASSIGNMENTS AND SUBCONTRACTS

23.1 The Contractor shall not assign any portion of this Agreement nor subcontract the Work in its entirety without the prior written consent of the Owner. Except as may be required under terms of the bonds required by the Contract Documents, no funds or sums of money due or to become due to the Contractor under the Contract Documents may be assigned.



GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

ARTICLE 24. MEASUREMENTS

- 24.1 Before ordering material or doing Work which is dependent for proper size or installation upon coordination with building conditions, the Contractor shall verify all dimensions and shall be responsible for the correctness of same. No consideration will be given for any claim based on differences between the actual dimensions and those indicated in the Contract Documents. Any discrepancies between the Contract Documents and the existing conditions shall be referred to the Designer for adjustment before any Work affected thereby is begun.

ARTICLE 25. CONTRACTOR AND SUBCONTRACTOR RELATIONSHIPS

- 25.1 Within thirty (30) days after initial receipt of the Construction Agreement for signatures the Contractor shall submit to the Designer and Owner for acceptance a current list of the names of Subcontractors and such other persons and organizations (including those who are to furnish materials or equipment fabricated to a special design) proposed for any and all portions of the Work. The Contractor shall provide this list at this time even if the Contractor was required to submit a list of proposed Subcontractors with the Contractor's bid. The Designer shall promptly reply to the Contractor in writing stating whether or not the Owner or the Designer, after due investigation, has objection to any such proposed person or entity or if it needs additional information to evaluate the persons on the list. Failure of the Designer to reply within ten (10) days after the Contractor has furnished all required information shall constitute notice of no objection.

The Contractor shall not contract with any such proposed person or entity to whom the Owner or the Designer has made reasonable objection. If the Designer or Owner has reasonable objection to any such proposed person or entity, the Contractor shall submit a substitute to whom the Owner and the Designer have no reasonable objection. The Contractor shall make no substitution for any Subcontractor, person, or entity previously allowed without first notifying the Designer and Owner in writing and no substitution may be made if the Owner or Designer makes a reasonable objection to such substitution.

- 25.2 The Contractor agrees that the terms of the Contract Documents, including all portions thereof, shall apply to all Subcontractors of the Contractor as if they were the Contractor, and that the Subcontractors of the Contractor shall, by means of their subcontracts, be bound by all the terms of the Contract Documents including, but not limited to, Article 26 of these General Conditions.
- 25.3 Payments to Subcontractors shall be made in accordance with the provisions of N.C. Gen. Stat. §143-134.1.

ARTICLE 26. USE OF PREMISES

- 26.1 The Contractor shall confine apparatus, the storage of materials, the operations of workers, and the disposal of material to limits indicated by law, ordinances, permits, and directions of the Designer, if any.
- 26.2 The Contractor shall not load or permit any part of the Work to be loaded with a weight that will endanger its safety, intended performance, or configuration.



GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

- 26.3 The Contractor shall enforce all of the Designer's instructions, including, but not limited to, those regarding signs, advertisements, fires, and smoking.

ARTICLE 27. CUTTING, PATCHING AND FITTING

- 27.1 The Contractor shall do all cutting, fitting, and patching of the Work that may be required to make its several parts come together properly and fit it to receive or to be received by Work shown in or which can be reasonably implied from the Contract Documents.

ARTICLE 28. DISPUTE RESOLUTION

- 28.1 The laws of the State of North Carolina shall apply to the interpretation and enforcement of this Agreement. Any and all suits or actions to enforce, interpret, or seek damages with respect to any provision of, or the performance or nonperformance of, this Agreement shall be brought in the General Court of Justice of North Carolina sitting in Wake County, North Carolina, and it is agreed by the parties that no other court shall have jurisdiction or venue with respect to such suits or actions. Appendix A shall be a part of the Contract Documents. Prior to initiating an action under this Article, any party to this Agreement shall initiate the mediation process as provided in Appendix A to these General Conditions of the Contract for Construction.

- 28.2 Any person or firm that expressly or impliedly agrees to perform labor or services or to provide material, supplies, equipment, work, performance or payment bonds, insurance or indemnification for the construction of the Project or the Work shall be deemed a party to this Agreement solely for the purpose of this Article 28. The Contractor, by means of its subcontracts, shall specifically require its Subcontractors to be bound by this Article.

ARTICLE 29. TAXES

- 29.1 The Contractor has included in the Contract Price and shall pay all taxes assessed by any authority on the Work or the labor and materials used therein. The Contractor shall maintain all tax records during the life of the Project and furnish the Owner with a complete listing of all taxes paid by taxing authority, invoice number, date, amount, etc. in a form acceptable to the Owner. The Contractor is required to maintain a file showing taxes paid on the Project for three (3) years after Final Payment or turn said documents over to the Owner for his files.

- 29.2 The following is a list of requirements to be followed by the Contractor in maintaining proper records and reporting the North Carolina Sales and Use Tax and Local Sales and Use Tax. The Contractor shall comply fully with the requirements outlined below, in order that the Owner may recover the amount of the tax permitted under the law.

- a) It shall be the Contractor's responsibility to furnish the Owner documentary evidence showing the materials used and sales and use tax paid by the Contractor and each of his Subcontractors. Such evidence shall be transmitted to the Owner with each pay request irregardless of whether taxes were paid in that period.



GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

- b) The documentary evidence shall consist of a certified statement by the Contractor and each of the Contractor's Subcontractors individually, showing total purchases of materials from each separate vendor and total sales and use taxes paid to each vendor. Certified statements must show the invoice number, or numbers, covered, and inclusive dates of such invoices.
- c) Materials used from Contractor's or Subcontractor's warehouse stock shall be shown in a certified statement at warehouse stock prices.
- d) The Contractor shall not be required to certify the Subcontractor's statements.

ARTICLE 30. OPERATION OF OWNER'S FACILITIES

- 30.1 The Contractor agrees that all Work done under the Contract Documents shall be carried on in such a manner so as to ensure the regular and continuous operation of the adjoining or adjacent facilities. The Contractor further agrees that the sequence of operations under the Contract Documents shall be scheduled and carried out so as to ensure said regular and continuous operation. The Contractor shall not close any areas of construction until so authorized by the Designer. The Contractor shall control operations to assure the least inconvenience to the public. Under all circumstances, safety shall be the most important consideration.

ARTICLE 31. THIRD PARTY BENEFICIARY CLAUSE

- 31.1 It is specifically agreed between the parties executing the Agreement that, with the specific exception set forth paragraph 7.24 hereof, and that exception only, the Contract Documents and the provisions therein are not intended to make the public, or any member thereof, a third-party beneficiary of the Agreement, or to authorize anyone not a party to the Contract Documents to maintain a suit for personal injuries or property damage pursuant to the terms of provisions of the Contract Documents.

ARTICLE 32. MEASUREMENT OF QUANTITIES

- 32.1 All Work completed under the Contract Documents shall be measured by the Contractor using United States customary units of measurement. The method of measurement and computations to be used in determination of quantities of material furnished and of Work performed under the Contract Documents shall be those methods set forth in the Contract Documents or, if not specifically set forth therein, the method generally recognized as conforming to good engineering practice.

ARTICLE 33. TERMINATION BY THE OWNER FOR CAUSE

- 33.1 If the Contractor fails to begin or complete the Work under the Contract Documents within the time specified, or fails to perform the Work with sufficient labor and equipment or with sufficient materials to insure the prompt completion of said Work, or shall perform the Work unsuitably or shall discontinue the prosecution of the Work for three (3) days, or if the Contractor shall become insolvent, be declared bankrupt, commit any act of bankruptcy or insolvency, allow any final judgment to stand against the Contractor or its affiliated



GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

companies unsatisfied for a period of forty-eight (48) hours, 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 to the Contractor and the Contractor's sureties of such delay, neglect, or default, specifying the same, and if the Contractor within a period of three (3) days after such notice shall not proceed in good faith and with reasonable speed to correct such delay, neglect, or default in accordance with such notice, the Owner shall have full power and authority, to the extent permitted by law, without violating the Contract Documents, to take the prosecution of the Work out of the hands of the Contractor, to appropriate or use any or all materials and equipment at the Project as may be suitable and acceptable, and may enter into an agreement for the completion of the Work or pursue such other methods as in the Owner's opinion shall be necessary or appropriate for the completion of the Work in an acceptable manner. All costs and charges incurred by the Owner in proceeding in accordance with the preceding sentence, including attorney's fees, and all costs incurred by the Owner in completing the Work shall be deducted from any money due or which becomes due the Contractor. If such costs and expenses incurred by the Owner shall be less than the sum which would have been payable under Contract Documents if it had been completed by the Contractor, then the Contractor shall be entitled to receive the difference, but if such costs and expenses shall exceed the sum which would have been payable under the Contract Documents, the Contractor and the Contractor's surety shall be liable to the Owner for and shall pay to the Owner the amount of such excess.

ARTICLE 34. TERMINATION OR SUSPENSION BY THE OWNER FOR CONVENIENCE

- 34.1 The Owner may, without cause, order the Contractor to terminate, suspend, delay, or interrupt the Work in whole or in part for such period of time as the Owner may determine.
- 34.2 If the Contractor is subsequently ordered by the Owner to resume the Work, any cost or expenses to which the Contractor may be entitled by reason of the suspension, delay, or interruption shall be recovered by means of a Change Order in accordance with Articles 13 and 14 hereof and the Contract Construction Schedule shall be adjusted in accordance with Article 13 hereof.
- 34.3 The Owner shall terminate the Work or portion thereof by written notice when the Contractor is prevented from proceeding with the Work as a direct result of an executive order of the President with respect to the prosecution of war or in the interest of national defense.
- 34.4 In the event of termination by the Owner under this Article, the Contractor shall be entitled to receive the reasonable and documented direct costs incurred prior to termination, including the cost of materials purchased for the Work which purchases cannot be canceled or which material cannot reasonably be used by the Contractor on other work, and the cost of closing down the Project in a safe and efficient manner, plus ten percent (10%) thereof for overhead and profit, subject to the following conditions:
 - a) When the Contract is terminated before completion of all items of Work, payment shall be made for the actual number of units or items of Work completed at the applicable contract prices, or as mutually agreed for items of Work partially complete. If a mutual agreement cannot be reached, the Owner shall have the



GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

authority to make such equitable adjustment as it deems warranted and the Final Payment shall be made accordingly.

- b) Reimbursement for organization of any Work and moving equipment to and from the job shall be considered when not otherwise provided for in the Contract Documents where the volume of completed Work is too small to compensate the Contractor for those expenses under unit prices. If a mutual agreement cannot be reached, the Owner will have the authority to make such equitable adjustments as it deems warranted and the Final Payment will be made accordingly.
- c) Materials obtained by the Contractor for the Work that have been inspected and accepted by the Designer and that are not incorporated in the Work shall, at the request of the Contractor, be purchased from the Contractor at the Contractor's actual cost as shown by receipted bills and actual costs records at such points of delivery as may be determined by the Owner.
- d) No payment shall be made by Owner to Contractor except as herein above provided. No claim for loss of anticipated profits shall be considered or allowed.
- e) Termination of the Contract shall not relieve the Contractor of his responsibilities for any completed portion of the Work nor shall it relieve his sureties of their obligation for and concerning any just claims arising out of the Work performed.

The Contractor shall not be entitled to any other compensation, including compensation for lost profit, lost opportunity, or any other direct or consequential cost, loss, or damage.

ARTICLE 35. MINORITY BUSINESS ENTERPRISE PROGRAM

- 35.1 The Contractor shall at all times comply with the latest edition of the Wake County Minority Business Enterprise Policy. All documentation substantiating compliance with the requirements of this program shall be delivered to the Owner as stipulated in the Contract Documents. A copy of the Wake County Minority Business Enterprise Policy is included in the Project Manual.

ARTICLE 36. GENERAL

- 36.1 If any provision of the Agreement shall be declared invalid or unenforceable, the remainder of the Agreement shall continue in full force and effect.
- 36.2 The titles to Articles herein are for convenience only, are not substantive parts of the General Conditions, and are not to be considered in interpreting the Contract Documents.

END OF GENERAL CONDITIONS OF THE
CONTRACT FOR CONSTRUCTION

**COUNTY OF WAKE
DETENTION ANNEX RENOVATION**

TYPICAL SUPPLEMENTARY GENERAL CONDITIONS

GENERAL

These Supplementary Conditions contain changes and additions to the project "GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION", as published herein. Where any Article of the General Conditions is modified or any Paragraph, Subparagraph or Clause thereof is modified or deleted by these Supplementary Conditions, the unaltered provisions of the Article, Paragraph, Subparagraph or Clause shall remain in effect.

ARTICLE 1 - DEFINITIONS

Paragraph 1.13: At the end of the existing paragraph, add the following:

The Contract Time is 490 calendar days, beginning on the Date of Commencement as specified in the written Notice-to-Proceed.

Paragraph 1.18: Delete the last sentence in its entirety and substitute the following in lieu thereof:

“A list of the Drawings is contained in the “Supplementary General Conditions.”

The Drawings applicable to this Contract are as follows:

GENERAL

- G0.1 COVER
- G1.1 SECURE AREA & SECURITY WALLS FLOOR PLAN
- G2.1 GENERAL INFORMATION - AIR BARRIER

LIFE SAFETY

- LS1.0 CODE SUMMARY
- LS1.1 LIFE SAFETY INFORMATION & OCCUPANCY SCHEDULE
- LS2.1 FIRE-RESISTIVE ASSEMBLIES

CIVIL

- C1.1 STAKING AND LANDSCAPE PLAN
- C2.1 EXISTING CONDITIONS AND DEMOLITION PLAN
- C3.1 GRADING
- C4.1 DETAILS
- C4.2 DETAILS

COUNTY OF WAKE

DETENTION ANNEX RENOVATION

ARCHITECTURAL

A0.1	GENERAL ARCHITECTURAL INFORMATION
A0.2	WALL/PARTITION TYPES
A1.0	ARCHITECTURAL SITE PLAN AND DETAILS
A1.1	SITE DETAILS
A1.2	DEMOLITION PLAN - PART A
A1.3	DEMOLITION PLAN - PART B
A1.4	DEMOLITION PLAN - PART C
A1.5	DEMOLITION REFLECTED CEILING PLAN - PART A
A1.6	DEMOLITION REFLECTED CEILING PLAN - PART B
A1.7	DEMOLITION REFLECTED CEILING PLAN - PART C
A2.0	OVERALL FLOOR PLAN
A2.1	FLOOR PLAN - PART A
A2.2	FLOOR PLAN - PART B
A2.3	FLOOR PLAN - PART C
A2.4	STORAGE CONTAINERS SHELTER
A3.0.1	FINISH SCHEDULE
A3.1.1	INTERIOR-EXTERIOR SIGNAGE
A3.2.1	DOOR & FRAME DETAILS
A3.3.1	DETENTION DOOR SCHEDULE
A3.4.1	DETENTION DOOR AND FRAME DETAILS
A4.1.1	BUILDING & INTERIOR ELEVATIONS
A7.1.1	TOILET ASSEMBLIES
A7.2.1	DETENTION EQUIPMENT DETAILS
A8.1	CASEWORK AND ELEVATIONS
A9.1	REFLECTED CEILING PLAN - PART A
A9.2	REFLECTED CEILING PLAN - PART B
A9.3	REFLECTED CEILING PLAN - PART C
A10.1	ROOF PLAN

ROOFING

R1.1	OVERALL ROOF PLAN
R1.2	ROOF PLAN
R3.1	ROOF SYSTEMS
R5.1	DETAILS
R5.2	DETAILS

COUNTY OF WAKE

DETENTION ANNEX RENOVATION

SECURITY

SE1.1	SECURITY ELECTRONICS DEMOLITION PLAN - PART A
SE1.2	SECURITY ELECTRONICS DEMOLITION PLAN - PART B
SE1.3	SECURITY ELECTRONICS DEMOLITION PLAN - PART C
SE2.0	SECURITY ELECTRONICS SITE PLAN
SE2.1	SECURITY ELECTRONICS FLOOR PLAN - PART A
SE2.2	SECURITY ELECTRONICS FLOOR PLAN - PART B
SE2.3	SECURITY ELECTRONICS FLOOR PLAN - PART C
	SECURITY ELECTRONICS FLOOR PLAN - STORAGE
SE2.4	CONTAINER AREA
SE3.1	CAMERA DETAILS
SE3.2	CAMERA SCHEDULE
SE4.0	SECURITY ELECTRONICS ONE LINE DIAGRAMS

FOOD SERVICE

FS.01	FOODSERVICE EQUIPMENT PLAN
FS.02	FOOD SERVICE EQUIPMENT SCHEDULE
FS.03	FOOD SERVICE PLUMBING PLAN
FS.04	FOOD SERVICE ELECTRICAL PLAN
FS.05	FOOD SERVICE COLD STORAGE DETAILS
FS.06	FOOD SERVICE EQUIPMENT DETAILS

STRUCTURAL

S0.1	GENERAL NOTES AND LEGENDS
S0.2	STATEMENT OF SPECIAL INSPECTIONS
S1.1	OVERALL FIRST FLOOR PLAN
S1.2	MORGUE CONTAINER SHELTER PLANS
S2.1	OVERALL ROOF PLAN
S2.2	DIRECT SUPERVISION PLATFORM PLAN AND SECTIONS
	FOUNDATION AND SLAB TYPICAL DETAILS AND
S3.1	SECTIONS
S4.1	TYPICAL MASONRY DETAILS
S4.2	TYPICAL FRAMING DETAILS
S4.3	FRAMING SECTIONS

PLUMBING

P0.1	LEGENDS
P1.1	PLUMBING - DEMOLITION FLOOR PLAN - PART A
P1.2	PLUMBING - DEMOLITION FLOOR PLAN - PART B
P1.3	PLUMBING - DEMOLITION FLOOR PLAN - PART C
P2.1	PLUMBING - FOUNDATION PLAN - PART A

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P2.2	PLUMBING - FOUNDATION PLAN - PART B
P2.3	PLUMBING - FOUNDATION PLAN - PART C
P2.4	PLUMBING - SANITARY FLOOR PLAN - PART A
P2.5	PLUMBING - SANITARY FLOOR PLAN - PART B
P2.6	PLUMBING - SANITARY FLOOR PLAN - PART C
P2.7	PLUMBING - DOMESTIC FLOOR PLAN - PART A
P2.8	PLUMBING - DOMESTIC FLOOR PLAN - PART B
P2.9	PLUMBING - DOMESTIC FLOOR PLAN - PART C
P3.1	ENLARGED PLANS AND RISER DIAGRAMS
P3.2	ENLARGED PLANS AND RISER DIAGRAMS
P5.1	PLUMBING DETAILS
P5.2	PLUMBING DETAILS
P6.1	SCHEDULES

FIRE PROTECTION

FP0.1	LEGENDS
FP2.1	FIRE PROTECTION FLOOR PLAN - AREA A
FP2.2	FIRE PROTECTION FLOOR PLAN - AREA B
FP2.3	FIRE PROTECTION FLOOR PLAN - AREA C

MECHANICAL

M0.1	LEGENDS
M0.2	SCHEDULES
M1.1.1	FLOOR PLAN - PART A - DEMOLITION
M1.2.1	FLOOR PLAN - PART B - DEMOLITION
M1.3.1	FLOOR PLAN - PART C - DEMOLITION
M1.4.1	MEZZANINE PLANS - DEMOLITION
M1.5.1	ROOF PLAN - DEMOLITION
M2.1.1	FLOOR PLAN - PART A - DUCTWORK
M2.2.1	FLOOR PLAN - PART B - DUCTWORK
M2.3.1	FLOOR PLAN - PART C - DUCTWORK
M2.3.2	FLOOR PLAN - PART C - PIPING
M2.4	ROOF PLAN
M3.1	ENLARGED PLANS
M3.2	ENLARGED PLANS
M5.1	DETAILS
M5.2	DETAILS
M6.1	FIREFIGHTER SMOKE CONTROL PANEL DETAIL
M7.1	CONTROLS
M7.2	CONTROLS

COUNTY OF WAKE DETENTION ANNEX RENOVATION

ELECTRICAL

- E0.1 LEGENDS
- E1.1 ELECTRICAL SITE PLAN
 - E1.1.1 FIRST FLOOR PLAN - DEMOLITION - PART A
 - E1.1.2 FIRST FLOOR PLAN - DEMOLITION - PART B
 - E1.1.3 FIRST FLOOR PLAN - DEMOLITION - PART C
- E1.2.1 MEZZANINE FLOOR PLAN - DEMOLITION
- E2.1.1 FIRST FLOOR PLAN - LIGHTING - PART A
- E2.1.2 FIRST FLOOR PLAN - POWER - PART A
- E2.1.3 FIRST FLOOR PLAN - LIGHTING - PART B
- E2.1.4 FIRST FLOOR PLAN - POWER - PART B
- E2.1.5 FIRST FLOOR PLAN - LIGHTING - PART C
- E2.1.6 FIRST FLOOR PLAN - POWER - PART C
- E2.2.1 MEZZANINE PLANS - LIGHTING
- E2.2.2 MEZZANINE PLANS - POWER
- E2.3 ROOF PLAN
- E2.4 STORAGE CONTAINER PLANS
- E2.5 FIRST FLOOR PLAN - TELECOMMUNICATIONS ROUGH IN
- E4.1 DETAILS
- E5.1 DIAGRAMS & SCHEDULES
- E6.1 PANELBOARD SCHEDULES

FIRE ALARM

- FA0.1 LEGEND
- FA1.1.1 FIRST FLOOR PLAN - DEMOLITION - FIRE ALARM
- FA1.1.4 MEZZANINE PLAN - DEMOLITION - FIRE ALARM
- FA2.1.1 FIRST FLOOR PLAN - FIRE ALARM
- FA2.1.4 MEZZANINE PLAN - FIRE ALARM

TELECOMMUNICATIONS

- T2.1 FIRST FLOOR PLAN - TELECOMMUNICATIONS
- T3.1 FIRST FLOOR PLAN - COMMUNICATION ZONES
- T5.1 TELECOMMUNICATIONS DIAGRAMS & DETAILS

COUNTY OF WAKE
DETENTION ANNEX RENOVATION

ARTICLE 3. FAMILIARITY WITH WORK, CONDITIONS AND LAWS

Paragraph 3.3: At the end of the existing paragraph, add the following paragraph:

“To ensure compliance with the E-Verify requirements of the General Statutes of North Carolina, all contractors, including any subcontractors employed by the contractor(s), by submitting a bid, proposal or any other response, or by providing any material, equipment, supplies, services, etc., attest and affirm that they are aware and in full compliance with Article 2 of Chapter 64, (NCGS64-26(a)) relating to the E-Verify requirements.”

“By signing this agreement; accepting this contract/purchase order; or submitting any bid, proposal, etc., vendors and contractors certify that as of the date of execution, receipt, or submission they are not listed on the Final Divestment List created by the NC Office of State Treasurer pursuant to NCGS 147 Article 6E, Iran Divestment Act, Iran Divestment Act Certification. Vendors and contractors shall not utilize any subcontractor that is identified on the Final Divestment List.”

“Any organization defined under NCGS 147-86.80(2), Divestment from Companies Boycotting Israel, shall not engage in business totaling more than \$1,000 with any company/business, etc. that boycotts Israel. A list of companies that boycott Israel is maintained by the NC Office of State Treasurer, pursuant to NCGS 147-86.81(a)(1). Any company listed as boycotting Israel is not eligible to do business with any State agency or political subdivision of the State.”

“If the source of funds for this contract is federal funds, the following federal provisions apply pursuant to 2 C.F.R. § 200.326 and 2 C.F.R. Part 200, Appendix II (as applicable): Equal Employment Opportunity (41 C.F.R. Part 60); Davis-Bacon Act (40 U.S.C. 3141-3148); Copeland “Anti-Kickback” Act (40 U.S.C. 3145); Contract Work Hours and Safety Standards Act (40 U.S.C. 3701- 3708); Clean Air Act (42 U.S.C. 7401-7671q.) and the Federal Water Pollution Control Act (33 U.S.C. 1251-1387); Debarment and Suspension (Executive Orders 12549 and 12689); Byrd Anti-Lobbying Amendment (31 U.S.C. 1352); Procurement of Recovered Materials (2 C.F.R. § 200.322); and Record Retention Requirements (2 CFR § 200.324).”

“In consideration of signing this Agreement, the Parties hereby agree not to discriminate in any manner on the basis of race, natural hair or hairstyles, ethnicity, creed, color, sex, pregnancy, marital or familial status, sexual orientation, gender identity or expression, national origin or ancestry, marital or familial status, pregnancy, National Guard or veteran status, religious belief or non-belief, age, or disability with reference to the subject matter of this Contract. The Parties agree to comply with the provisions and intent of Wake County Ordinance SL 2017-4. This anti-discrimination provision shall be binding on the successors and assigns of the Parties with reference to the subject matter of this Contract.”

COUNTY OF WAKE DETENTION ANNEX RENOVATION

Add the following paragraph:

- “3.5 A Pre-Bid Conference will be held at 2 PM local prevailing time on November 5, 2025, at the Wake County Detention Center Annex, located at 3400 Hammond Road. All prime bidder Contractors are to be present. Purpose of conference is for prospective Bidders to familiarize themselves with the site and to ask questions pertaining to the Contract Documents. Bidders are reminded that no oral interpretations of meaning of Drawings and Specifications can be made. Conflicts in documents, if any, will be resolved by written addendum. (Reference “Instructions to Bidders, Paragraph 5 (for formal).”) **All Contractors shall be advised that there is currently construction activity at the site for a separate contract. All Contractors shall bring appropriate construction site PPE (hard hat, gloves, eye protection, sturdy closed toe shoes, and high visibility vest/clothing at minimum) and shall be required to wear PPE during the pre-bid walkthrough.**

ARTICLE 5. INSURANCE AND INDEMNITY

Paragraph 5.1.2: In addition to all other endorsements required by the General Conditions, if the Contractor is required to transport, dispose of or otherwise handle hazardous or toxic waste, material, chemicals, compounds or substances, the policy of insurance shall be further endorsed to include the following:

Insurance Service Office (ISO) Form #CA 00 01 06 92 or its equivalent, amending exclusion 11 in the following manner:

- i. Delete section a. (1) a.: (Pollution) "being transported or towed by, or handled for movement into, onto or from, the covered auto."
- ii. Delete section a. (1) b.: "Otherwise in the course of transit by the insured."

The Contractor and transporter must comply with all applicable DOT and EPA requirements.

Paragraph 5.1.4: Add the following Paragraph [as necessary if the Contractor or its Subcontractor is required to consolidate, transfer, transport, dispose of, store or otherwise handle hazardous or toxic waste, material, chemicals, compounds or substances at any location]:

“Pollution Legal Liability (PLL)”

A PLL policy must be provided for the Project. Coverage must be sudden and non-sudden, and include:

**COUNTY OF WAKE
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- a) Bodily injury, sickness, disease, mental anguish, or shock sustained by any person, including death;
- b) property damage including physical injury to or destruction of tangible property including the resulting loss of use thereof, cleanup costs, and the loss of use of tangible property that has not been physically injured or destroyed; and
- c) Defense including costs, charges, and expenses incurred in the investigation, adjustment, or defense of claims for such compensatory damages.

The Owner must be named as Additional Insured, and a Non-Owned Disposal Site Endorsement must be provided, scheduling the appropriate landfill.

Minimum PLL limits of coverage shall be:

Per Loss	\$1,000,000
All Losses	\$2,000,000

ARTICLE 6. OTHER RECORD DOCUMENTS AND SUBMITTALS

Paragraph 6.1: At the end of the existing paragraph, add the following:

“The Contract Documents shall be furnished to the General Contractor electronically in PDF format.”

ARTICLE 7. CONTRACTOR

Paragraph 7.2: Use this paragraph in lieu of the existing paragraph:

“The Contractor shall keep on the Project at all times during its progress a competent Project Manager and a competent Resident Superintendent and necessary assistants who shall not be replaced without prior written approval by the Architect except under extraordinary circumstances, in which event immediate written notice shall be given to the Architect and the Owner. The Project Manager and Resident Superintendent shall each have a minimum of ten (10) years experience on projects of similar scope and complexity with job responsibilities equivalent to those required on this Project. At any time, the Owner, in its sole discretion, may require the Contractor to replace the Project Manager and Resident Superintendent or both with an experienced and competent person or persons upon seven (7) days written notice from the Owner to the Contractor. Such replacement shall be at the Contractor’s expense and at no cost to the Owner. The Project Manager shall be the Contractor’s

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representative at the Project and shall have full authority to act on behalf of the Contractor and to receive any and all notices or instructions given pursuant to the Contract Documents.”

Paragraph 7.13: Amend with the addition of the following paragraph:

“The General Contractor shall secure and pay for all building permits, including plumbing, electrical, HVAC and for the permit from the office of the Fire Marshall. The Cost for the Express Permit Review, if necessary, will be paid by others and is not the responsibility of the Contractor.”

ARTICLE 10. DESIGNER

Add the following paragraphs:

“10.5 As a part of its Basic Services under the Owner-Designer Agreement, the Designer will conduct a single site visit to determine Substantial Completion of the Work. If, after the performance of said site visit, the Designer determines that the Work is not substantially complete, successive site visits to determine Substantial Completion will be deemed Additional Services under the Owner-Designer Agreement. The Contractor shall be liable to the Owner for any Designer’s fees incurred as a result of any such Additional Services of the Designer. Any funds due under this paragraph may be deducted by the Owner from the amounts due the Contractor for such additional Designer’s fees and paid directly to the Designer. Should the cost for such Additional Services of the Designer exceed the amount due or to become due to the Contractor, then the Contractor and his sureties shall be liable for and shall pay to the Owner the amount of any such excess.

“10.6 As a part of its Basic Services under the Owner-Designer Agreement, the Designer will conduct a single site visit to determine Final Completion of the Work. If, after the performance of said site visit, the Designer determines that the Work is not complete, successive site visits to determine Final Completion of the Work will be deemed Additional Services under the Owner-Designer Agreement. The Contractor shall be liable to the Owner for any Designer’s fees incurred as a result of any such Additional Services of the Designer. Any funds due under this paragraph may be deducted by the Owner from the amounts due the Contractor for such additional Designer’s fees and paid directly to the Designer. Should the cost for such Additional Services of the Designer exceed the amount due or to become due to the Contractor, then the Contractor and his sureties shall be liable for and shall pay to the Owner the amount of any such excess.”

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ARTICLE 13 - CONTRACT TIME

Paragraph 13.18: Add the following:

“If the Contractor fails to achieve Substantial Completion of the Work within the Contract Time and as otherwise required by the Contract Documents, the Owner shall be entitled to retain or recover from the Contractor, as Step One Liquidated Damages and not as a penalty, the following per diem amount commencing upon the first day following expiration of the Contract Time and continuing until the actual date of Substantial Completion. Such liquidated damages are hereby agreed to be a reasonable pre-estimate of damages the Owner will incur as a result of delayed Substantial Completion of the Work:

One Thousand Dollars (\$1,000) per consecutive calendar day

If the Contractor fails to achieve Final Completion of the Work within thirty (30) consecutive calendar days of the actual date of Substantial Completion of the Work, the Owner shall be entitled to retain or recover from the Contractor, as Step Two Liquidated Damages and not as a penalty, the following per diem amount commencing upon the first day following the actual date of Substantial Completion and continuing until the actual date of Final Completion. Such liquidated damages are hereby agreed to be a reasonable pre-estimate of damages the Owner will incur as a result of delayed Final Completion of the Work:

Five Hundred Dollars (\$500) per consecutive calendar day

The Owner may deduct liquidated damages described above from any unpaid amounts then or thereafter due the Contractor under this Agreement. Should the amount of any liquidated damages exceed the amount due or to become due to the Contractor, then the Contractor and his sureties shall be liable for and shall pay to the Owner the amount of any such excess.”

ARTICLE 29 – TAXES

Paragraph 29.1: Add the following to the existing paragraph:

“The Contractor is to use the Sales Tax Reporting Form attached to the contract documents for reporting taxes paid.

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Add the following paragraph under Article 29

29.3 This project is considered a “Capital Improvement” with respect to Real Property Contracts, and the collection of State sales and use tax, as referenced in North Carolina General Statutes and further clarified in sales and use tax bulletins issued by the North Carolina Department of Revenue. It shall be the responsibility of the Contractor to issue any affidavits of capital improvement to their subcontractors as necessary.

ARTICLE 36. GENERAL

Add the following paragraph:

“36.3 Any specific requirement in this Contract that the responsibilities or obligations of the Contractor also apply to a Subcontractor is added for emphasis and is also hereby deemed to include a Subcontractor of any tier. The omission of a reference to a Subcontractor in connection with any of the Contractor’s responsibilities or obligations shall not be construed to diminish, abrogate, or limit any responsibilities or obligations of a Subcontractor of any tier under the Contract Documents or the applicable subcontract.”

END OF SUPPLEMENTARY GENERAL CONDITIONS

**APPENDIX A
TO GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION**

**DISPUTE RESOLUTION PROCEDURES FOR WAKE COUNTY BUILDING CONSTRUCTION
RENOVATION AND REPAIR PROJECTS**

Table of Rules

Rule

- 1. Initiating Mediated Settlement Conferences**
 - A. Purpose of Mandatory Settlement Conferences
 - B. Initiating the Dispute Resolution Process
- 2. Selection of Mediator**
 - A. Mediator Listing
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 - C. Disqualification of Mediator
- 3. The Mediated Settlement Conference**
 - A. Where Conference is to be Held
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- 4. Duties of Parties and Other Participants in Formal Dispute Resolution Process**
 - A. Attendance
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 - C. Payment of Mediation Fee
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- 5. Authority and Duties of Mediators**
 - A. Authority of Mediator
 - B. Duties of Mediator
- 6. Compensation of the Mediator**
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- 8. Definitions**
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RULE 1 INITIATING MEDIATED SETTLEMENT CONFERENCES

A Purpose of Mandatory Settlement Conferences. Pursuant to G.S. §143-128(f1) and 143-135.26(11), these Rules are promulgated to implement a mediated settlement program designed to focus the parties' attention on settlement rather than on claim preparation and to provide an opportunity for orderly settlement negotiations to take place. Nothing herein is intended to limit or prevent the parties from engaging in settlement procedures voluntarily at any time prior to or during commencement of the dispute resolution process.

B Initiating the Dispute Resolution Process

Any party to a County public construction contract (referred to herein generally as the "Contract") governed by Article 8. Ch. 143 of the General Statutes and identified in G.S. § 143-128(f1) and who is a party to a dispute arising out of the Contract and the construction process in which the amount in controversy is at least \$15,000 may submit a written request to the County for mediation of the dispute.

Prior to submission of a written request for mediation to the County, the parties should give notice of any and all claims in accordance with their respective contracts, obtain decisions on the claims as required or allowed by their respective contracts, and attempt to resolve the dispute according to the terms and conditions in their respective contracts. The Mediator may adjourn any mediated settlement conference if the Mediator believes, in his or her sole discretion, that the parties have not satisfied all of the terms and conditions of their respective contracts and that doing so will enhance the prospects for a negotiated settlement.

C Condition Precedent to Litigation. Before any party to a Contract may commence a civil action against the County seeking remedies for breach or non-performance of the Contract by the County, said party must first initiate the dispute resolution process under these rules and attend the mediated settlement conference.

RULE 2 SELECTION OF MEDIATOR

A Mediator Listing. A list of Mediators acceptable to the County is attached to and incorporated by reference into these Rules. The party requesting mediation shall select a Mediator from the designated list. If the County fails to provide a list of acceptable mediators, the list of Mediators shall be deemed to be the list of mediators certified by the North Carolina Dispute Resolution Commission to conduct mediated settlement conferences in the North Carolina Superior Courts.

B Selection of a Mediator. The party requesting mediation shall select a Mediator from the County's list of Mediators and shall file, with the County, a Notice of Selection of Mediator within 21 days of the request for mediation. Such notice shall state the name, address, and phone number of the Mediator selected. If the Mediator selected is not available or declines to participate for any reason, the requesting party shall select

another person from the County's list of Mediators. If the party requesting mediation does not select and designate a mediator within 21 days of the request for mediation, the County shall have the right in its absolute discretion to appoint a mediator from its list of Mediators.

- C Disqualification of Mediator.** Any party may request replacement of the Mediator for good cause. Nothing in this provision shall preclude Mediators from disqualifying themselves.

RULE 3 THE MEDIATED SETTLEMENT CONFERENCE

- A Where Conference is to be Held.** Unless all parties and the Mediator otherwise agree, the mediated settlement conference shall be held in Wake County. The Mediator shall be responsible for reserving a place, making arrangements for the conference, and giving timely notice of the time and location of the conference to all attorneys, unrepresented parties and other persons or entities required to attend.
- B When Conference is to be Held.** The mediation shall be completed within 90 days after selection of the Mediator.
- C Request to Accelerate or Extend Deadline for Completion.** Any party or the Mediator may request the County to accelerate or extend the deadline for completion of the conference. Such request shall state the reasons the extension is sought and shall be served by the moving party upon the other parties and the Mediator. Objections to the request must be promptly communicated to the County and to the Mediator.

The County, with the concurrence of the designated Mediator, may grant the request by adjusting the time for completion of the conference.

- D Recesses.** The Mediator may recess the mediation conference at any time and may set times for reconvening. If the Mediator determines the time and place where the conference is to reconvene before the conference is recessed, no further notice is required to persons present at the conference.
- E Project Delay.** The mediated settlement conference that results from a construction contract dispute shall not be cause for the delay of the construction project.

RULE 4 DUTIES OF PARTIES AND OTHER PARTICIPANTS IN FORMAL DISPUTE RESOLUTION PROCESS

A Attendance

1. All parties to the dispute must designate an official representative to attend the mediation.

2. "Attendance" means physical attendance, not by telephone or other electronic means. Any attendee representing a party must have authority from that party to bind it to any agreement reached as a result of the mediation.
3. Attorneys representing parties may attend the mediation, but are not required to do so.
4. Sureties and insurance company representatives are required to physically attend the mediation unless the Mediator and all of the other parties to the mediation excuse their attendance or consent to their attendance by telephone or other electronic means.
5. The parties who attend a duly scheduled mediation conference shall have the right to recover their share of the Mediator's compensation from any party or parties who fail to attend the conference without good cause.

B Finalizing Agreement. If an agreement is reached in the conference, the terms of the agreement shall be confirmed in writing and signed by all parties.

C Mediation Fees charged by the Mediator shall be paid in accordance with G.S. § 143-128(f1).

D Failure to compensate Mediator. Any party's failure to compensate the Mediators in accordance with G.S. § 143-128(f1) shall subject that party to a withholding of said amount of money from the party's monthly payment by the County.

Should the County fail to compensate the Mediator, it shall hereby be subject to a civil cause of action from the Mediator for the 1/3 portion of the Mediator's total fee as required by G.S. § 143-128(f1).

RULE 5 AUTHORITY AND DUTIES OF MEDIATORS

A Authority of Mediator

1. **Control of Conference.** The Mediator shall at all times be in control of the conference and the procedures to be followed.
2. **Private Consultation.** The Mediator may communicate privately with any participant or counsel prior to and during the conference. The fact that private communications have occurred with a participant shall be disclosed to all other participants at the beginning of the conference.
3. **Scheduling the Conference.** The Mediator shall make a good faith effort to schedule the conference at a time that is convenient with the participants, attorneys and Mediator. In the absence of agreement, the Mediator shall select the date for the conference.

4. Determining good cause for a party's failure to appear at a scheduled mediation conference.

B Duties of Mediator

1. The Mediator shall define and describe the following at the beginning of the conference:
 - a. The process of mediation.
 - b. The difference between mediation and other forms of conflict resolution.
 - c. The costs of the mediated settlement conference.
 - d. That the mediated settlement conference is not a trial, the Mediator is not a judge, and the parties retain their legal rights if they do not reach settlement; however, the Mediator will advise all parties that failure to appear at mediation without good cause may result in imposition of sanctions and may be asserted as a bar to lawsuits by claimants who have failed to exhaust this administrative remedy.
 - e. The circumstances under which the Mediator may meet and communicate privately with any of the parties or with any other person.
 - f. Whether and under what conditions communications with the Mediator will be held in confidence during the conference.
 - g. The inadmissibility of conduct and statements as provided by GS §7A-38.1(1).
 - h. The duties and responsibilities of the Mediator and the participants.
 - i. That any agreement reached will be reached by mutual consent.
2. Disclosure: The Mediator has a duty to be impartial and to advise all participants of any possible bias, prejudice or partiality.
3. Declaring Impasse: The Mediator may determine at any time during the mediation conference that an impasse exists and that the conference should end.
4. Reporting Results of Conference. The Mediator shall submit a written report to the County and the other parties within 10 days of the conference stating whether or not the parties reached an agreement. The Mediator's report shall indicate the absence of any party from the mediated settlement conference without permission or good cause.
5. Scheduling and Holding the Conference. It is the duty of the Mediator to schedule the conference and conduct it prior to the deadline of completion set by the rules. The Mediator shall strictly observe deadlines for completion of the conference unless said time limit is changed by agreement of the parties.

RULE 6 COMPENSATION OF THE MEDIATOR

- A** The parties shall compensate the Mediator for mediation services at the rate proposed by the Mediator and agreed to by the parties at the time the Mediator is selected.

RULE 7 RULE MAKING

- A** These Rules may be amended by the County at any time. Amendments will not affect mediations where claims and/or requests for mediation have been filed at the time the amendment takes effect

RULE 8 DEFINITIONS

- A** “County” shall mean the County of Wake, North Carolina
- B** “Project Designer” is that person or firm stipulated as project designer in the Contract Documents for the project.
- C** “Claim” is a demand or assertion by a party seeking adjustment or interpretation of Contract terms, payment of money, extension of time or other relief with respect to the terms of the Contract. The term “Claim” also includes other disputes and matters in question between the parties to a Contract involved in the County’s building construction renovation and repair projects arising out of or relating to the Contract or the construction process. Claims must be initiated by a written notice. The responsibility to substantiate Claims shall rest with the party making the Claim.
- D** “Good Cause” generally includes any circumstance beyond the control of a party, which prevents that party from meeting obligations. When good cause is asserted as an excuse for a party’s failure to appear at a mediation conference or to otherwise comply with the requirements of these Rules, the Mediator, in his or her sole discretion, will determine whether good cause exists to excuse the party’s failure to appear or otherwise comply with these rules.

RULE 9 TIME LIMITS

- A** Any time limit provided for by these Rules may be waived or extended at the sole discretion of the County if no Mediator has been selected and at the discretion of the County with concurrence of the Mediator if a Mediator has been selected.

MEDIATOR LIST

Name	Bar #	Address	Phone	Fax	Email
David M. Barnes	12854	PO Box 10096 Raleigh, NC 27605	919-783-2812	919-783-1075	dmbarnes@poynerspruill.com
Robert Beason	5502	PO Box 52270 Durham, NC 27717	919-419-8979	919-403-8533	rbeason@beasonellis.com
William A. Blancato	12729	633 W. 4 TH Street, Suite 150 Winston-Salem, NC 27101	336-725-9416	336-725-5129	blancato@bdl-law.com
Richard T. Boyette	7623	PO Box 27808 Raleigh, NC 27611	919-828-5100	919-828-2277	rtb@cshlaw.com
Jacqueline R. Clare	10277	1011 Vance Street Raleigh, NC 27608	919-755-9979	919-755-9512	jclare@mindspring.com
Thomas C. Duncan	1255	PO Box 989 Greensboro, NC 27402	910-379-1390	910-379-1198	duncan@hillevans.com
Sidney Smith Eagles	1271	PO Box 27525 Raleigh, NC 27611	919-755-8771	919-755-8800	sid.eagles@smithmoorelaw.com
Rene Stemple Ellis	DC/P A	PO Box 52270 Durham, NC 27712	919-417-9979	919-403-8533	rellis@beasonellis.com
Marshall Gallop	6626	PO Box 7100 Rocky Mount, NC 27804	252-937-2200	252-937-8100	mgallop@bwsb.com
Allen Holt Gwyn		PO Box 20744 Greensboro, NC 27420	336-691-9222	336-691-9259	ahgwyn@cgspllc.com
Jonathan R. Harkavy	5238	PO Box 29269 Greensboro, NC 27429	336-370-4200	336-274-8490	jharkavy@aol.com
Joseph R. John	2361	11800 Black Horse Run Raleigh, NC 27613	919-676-8796	919-676-8796	jo638sr@aol.com
J. Anderson Little	6730	PO Box 16205 Chapel Hill, NC 27514	919-967-6611	919-967-3212	jandersonlittle@nc.rr.com
James D. Llewellyn	2732	PO Box 567 Atlantic Beach, NC 28512	252-559-2714	252-726-1973	judgelew@embarqmail.com

Name	Bar #	Address	Phone	Fax	Email
Charles K. McCotter		PO Box 12800 Newbern, NC 28561-2800	252-635-1005	252-635-5050	ckm@justice.com
Peter M. McHugh	6269	915 Country Club Drive Reidsville, NC 27320	336-361-9557	336-361-9569	pmchugh@triad.rr.com
Charles E. Nichols	10448	PO Box 20389 Raleigh, NC 27619-0389	919-787-8800	919-781-0811	nichols@manningfulton.com
Jeffrey B. Parsons	16006	PO Box 30933 Raleigh, NC 27622	919-789-9242	919-789-9242	jparsons@cgspllc.com
J. Dickson Phillips	8941	PO Drawer 4825 Chapel Hill, NC 27515	919-967-8989	919-419-1429	dphillips@lapgh.com
Lacy M. Presnell	7272	PO Box 10867 Raleigh, NC 27605	919-782-1441	919-782-2311	lpresnell@bdppa.com
John L. Shaw	3950	PO Box 10096 Raleigh, NC 27605	919-783-6400	919-783-1075	jshaw@poynerspruill.com
Edwin M. Speas	4112	PO Box 10096 Raleigh, NC 27607	919-783-6400	919-783-1075	espeas@poynerspruill.com
Odes L. Stroupe	4983	3105 Glenwood Ave., Suite 300 Raleigh, NC 27612	919-881-0338	919-881-9548	stroupe@bcs-law.com
Arthur A. Vreeland	6899	4 Parkmont Court Greensboro, NC 27408	336-288-7500	336-288-7500	aavreeland@aol.com
Charles P. Younce	4891	PO Box 3486 Greensboro, NC 27402	336-379-0123	336-379-9894	cyounce@jymmlaw.com
Julia F. Youngman	21320	PO Box 33550 Raleigh, NC 27636	919-865-7000	919-865-7010	julie_youngman@elliswinters.com

APPENDIX B
CONTRACTOR'S SALES TAX REPORT
N.C. STATE & LOCAL SALES TAXES PAID

OWNER: Wake County

CONTRACTOR/SUBCONTRACTOR: _____

ADDRESS: _____

PROJECT: Detention Annex Renovation

FOR PERIOD: _____

TO: _____

[illegible]

TOTALS _____

I hereby certify that, during the period stated above, North Carolina sales and use taxes were paid as listed above, with respect to building materials, supplies, fixtures, and equipment which have become a part of, or annexed to, a building or structure erected, altered or repaired for the County of Wake, and that the vendors from whom the property was purchased, the dates and numbers of the invoices covering the purchases, the total amount of the invoices of each vendor, the North Carolina sales and use taxes paid thereon, and the cost of property withdrawn from warehouse stock and North Carolina sales or use taxes paid thereon are as set forth above.

Sworn to and Subscribed before me, this _____ day of _____, 20__.

By: _____

Notary

My Commission expires_____.

Title: _____

**SECTION 011000
SUMMARY**

PART 1 GENERAL

1.01 PROJECT

- A. Project Name: Detention Annex Renovation.
- B. Owner's Name: Wake County, North Carolina.
- C. Architect's Name: Moseley Architects of Charlotte, NC.

1.02 CONTRACT DESCRIPTION

- A. Contract Type: A single prime contract based on a Stipulated Price (Fixed Sum) as described in the Bidding and Contractual Requirements (Division 00) included in this Project Manual.

1.03 PROFESSIONAL SEALS

- A. Use of Professional Seals on Bidding, Procurement, and Contract Documents: For the purposes of this paragraph, the term "Regulant" refers to the individual who signs and seals parts of the Contract Documents (e.g. the Drawings and Specifications). Certain information has been excerpted verbatim from a source or sources (e.g., UL assemblies, SMACNA details, applicable state/jurisdiction building code) which was considered or used by Regulant in preparing parts of the Contract Documents, as follows:
 - 1. The excerpted information was neither prepared under the direct control nor personal supervision nor created by the Regulant, as it was prepared by the source and owner of the excerpted information.
 - 2. For purposes of bidding, procuring, and performance of the Work, and in any event of conflicts or ambiguities between the excerpted information in the Contract Documents and the requirements of applicable codes and standards, provide the better quality or greater quantity of Work which, at a minimum, complies with the requirements of the applicable codes and standards.
 - 3. Advise Architect immediately upon becoming aware of requirements of the Work which are not consistent with the requirements of the excerpted information.
 - 4. Attribution is acknowledged for information obtained and included herein verbatim from other source or sources.
 - 5. Regulant has taken into consideration and used certain excerpted information from other sources which are applicable to the Contract Documents, and the Regulant indicates by its seal that it is assuming responsibility for its services in use and application of the excerpted information to the requirements of Work, but not for the excerpted information itself which was prepared by others. Regulant does not indicate by its seal that it is responsible for use or application of other information in such source or sources which was not included herein.

1.04 OWNER OCCUPANCY

- A. Owner intends to occupy the Project upon Substantial Completion.
- B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
- C. Schedule the Work to accommodate Owner occupancy.
 - 1. Maintain routes of egress and life safety systems for Owner and occupants at all times.

1.05 CONTRACTOR USE OF SITE AND PREMISES

- A. Construction Operations: Limited to areas noted on Drawings.
 - 1. Locate and conduct construction activities in ways that will limit disturbance to site.
- B. Provide access to and from site as required by law and by Owner:
 - 1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
 - 2. Do not obstruct roadways, sidewalks, or other public ways without permit.
- C. Existing building spaces may not be used for storage.
- D. Existing building shall be maintained weathertight. Do not modify elements of the existing building except as indicated on the Construction Documents. Repair damage to the existing building due to construction activity.
- E. Time Restrictions:
 - 1. Comply with local regulations for hours of work, noise ordinances, and similar requirements.
- F. Utility Outages and Shutdown:
 - 1. Limit disruption of utility services to hours the building is unoccupied.
 - 2. Do not disrupt or shut down life safety systems, including but not limited to fire sprinklers and fire alarm system, without 7 days notice to Owner and authorities having jurisdiction.
 - 3. Prevent accidental disruption of utility services to other facilities.
- G. Controlled Substances: The use of alcohol and drugs is not permitted on the Project site. Provide a designated outdoor smoking area for construction personnel that is at least 30 feet away from the building.

1.06 SPECIFICATION SECTIONS APPLICABLE TO ALL WORK

- A. The provisions of the Owner/Contractor agreement, General Conditions of the Contract, Supplementary Conditions (if any), and all Division 01 sections shall apply to all sections of the Project Manual.

1.07 SECURITY PROVISIONS

- A. Background Check: The Owner requires that a background check be performed on all personnel working on the site. Comply with Owner's requirements for screening service to be used. Maintain a list of all accredited persons, submit a copy to Owner on request.
- B. Identification Badges: Provide identification badges to each person authorized to enter premises. Badge shall include personal photograph, name, employer, expiration date, and an assigned number. Have personnel return badges to Contractor after completion of their portion of the Work.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 011000

**SECTION 012000
PRICE AND PAYMENT PROCEDURES**

PART 1 GENERAL

1.01 SCHEDULE OF VALUES

- A. Use Schedule of Values Form: AIA G703, unless otherwise agreed to by Owner in writing.
- B. Forms filled out by hand will not be accepted.
- C. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification section. Identify site mobilization.
- D. Include in each line item, the amount of Allowances specified in this section. For Quantity Allowances, identify quantities taken from Contract Documents multiplied by the unit cost to achieve the total for the item.
- E. Include separately from each line item, a direct proportional amount of Contractor's overhead and profit.
- F. Revise schedule to list approved Change Orders, with each Application For Payment.
 - 1. When a Change Order includes multiple PCOs, break down the total Change Order to include each PCO as an individual line item.

1.02 APPLICATIONS FOR PROGRESS PAYMENTS

- A. Payment Period: Submit at intervals stipulated in the Agreement.
- B. Use Form AIA G702 and Form AIA G703.
- C. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.
- D. Forms filled out by hand will not be accepted.
- E. For each item, provide a column for listing each of the following:
 - 1. Item Number.
 - 2. Description of work.
 - 3. Scheduled Values.
 - 4. Previous Applications.
 - 5. Work in Place and Stored Materials under this Application.
 - 6. Authorized Change Orders.
 - 7. Total Completed and Stored to Date of Application.
 - 8. Balance to Finish.
 - 9. Retainage.
- F. Execute certification by signature of authorized officer.
- G. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.
- H. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of work.
 - 1. When a Change Order includes multiple PCOs, break down the total Change Order to include each PCO as an individual line item.
- I. Submit one electronic and three hard-copies of each Application for Payment.

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- J. Include the following with the application:
 - 1. Transmittal letter as specified for submittals in Section 013000.
 - 2. Construction progress schedule, revised and current as specified in Section 013000.
 - 3. Partial release of liens from major subcontractors and vendors.
 - 4. Affidavits attesting to off-site stored products.

1.03 MODIFICATION PROCEDURES

- A. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue instructions directly to Contractor on AIA Document G710 "Architect's Supplemental Instructions."
- B. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within 14 days, unless otherwise indicated in Proposal Request.
- C. Contractor may propose a change by submitting a request for change to Architect, describing the proposed change and its full effect on the work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation.
- D. For other required changes, Architect will issue a Construction Change Directive, on AIA Document G714, signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
 - 1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
 - 2. Promptly execute the change.
- E. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
 - 1. For change requested by Architect for work falling under a fixed price contract, the amount will be based on Contractor's price quotation.
 - 2. For change requested by Contractor, the amount will be based on the Contractor's request for a Change Order as approved by Architect.
 - 3. For pre-determined unit prices and quantities, the amount will be based on the fixed unit prices.
- F. Substantiation of Costs: Provide full information required for evaluation.
 - 1. Provide the following data:
 - a. Quantities of products, labor, and equipment.
 - b. Taxes, insurance, and bonds.
 - c. Overhead and profit.
 - d. Justification for any change in Contract Time.
 - e. Credit for deletions from Contract, similarly documented.
 - 2. Support each claim for additional costs with additional information:
 - a. Origin and date of claim.
 - b. Dates and times work was performed, and by whom.
 - c. Time records and wage rates paid.
 - d. Invoices and receipts for products, equipment, and subcontracts, similarly documented.

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- G. Execution of Change Orders: Architect will issue Change Orders on AIA Document G701 for signatures of parties as provided in the Conditions of the Contract.
- H. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.
- I. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.

1.04 APPLICATION FOR FINAL PAYMENT

- A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.
- B. Application for Final Payment will not be considered until the following have been accomplished:
 - 1. All closeout procedures specified in Section 017000.
- C. Provide evidence and supporting data for the following, as attachments to the Application for Final Payment:
 - 1. AIA G706, "Contractor's Affidavit of Payment of Debts and Claims."
 - 2. AIA G706A, "Contractor's Affidavit of Release of Liens."
 - 3. AIA G707, "Consent of Surety to Final Payment."
 - 4. Copy of Certificate of Occupancy.
 - 5. Settlement of all debts and claims, including liquidated damages, taxes, and fees.
 - 6. Utility meter readings, fuel levels, and similar measurements, as of the date of turn over to the Owner.
 - 7. Certificates for insured products, and certificate of insurance for completed operations.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 012000

**SECTION 012100
ALLOWANCES**

PART 1 GENERAL

1.01 SUBMITTALS

- A. Allowance Proposal: Submit initial proposal for purchase of products and materials, on Change Order form.
- B. Supporting Documentation:
 - 1. Products and Material: Provide invoices and other documents as required, for products and materials indicating quantities, prices, taxes, delivery fees, and other costs.
 - 2. Labor and Installation: Provide time sheets and other documents as required, indicating all on-site Subcontractor costs, including hours worked, quantity or amount of product/material installed, hourly wages, and Subcontractor overhead and profit.

1.02 LUMP-SUM AND QUANTITY ALLOWANCES

- A. Costs Included in Lump-Sum and Quantity Allowances: All Subcontractor's costs: Cost of products and materials, taxes, freight, delivery, receiving and handling, labor and installation, Subcontractor overhead and profit.
- B. Costs Not Included in Lump-Sum and Quantity Allowances: All General Contractor's costs: General coordination, GC's overhead and profit.
- C. Contractor Responsibilities:
 - 1. Assist Architect in selection of products.
 - 2. Obtain proposals from suppliers and installers and offer recommendations.
 - 3. On notification of which products have been selected, execute purchase agreement with designated supplier and installer.
 - 4. Arrange for and process shop drawings, product data, and samples. Arrange for delivery.
- D. Contractor shall return unused products and materials that were purchased under allowance to the manufacturer or supplier, and provide credit to the Owner.
- E. At closeout of contract, differences in costs for each allowance will be adjusted by Change Order to increase the contract sum or to provide a credit to the Owner, as applicable.

1.03 LUMP SUM ALLOWANCE SCHEDULE

- A. Lump Sum Allowances, General: Include all lump sum allowances in the Base Bid price on the Bid Proposal Form.
- B. Lump Sum Allowance No. 1: Include the stipulated sum of \$1,400,000 for security electronics.
- C. Lump Sum Allowance No. 2: Include the stipulated sum of \$340,000 for data systems.
- D. Lump Sum Allowance No. 3: Include the stipulated sum of \$150,000 for cleaning of the existing building.
- E. Lump Sum Allowance No. 4: Include the stipulated sum of \$10,000 for interior and exterior panel signage, as specified in Division 10 Section "Signage."
- F. Lump Sum Allowance No. 5: Include the stipulated sum of \$150,000 for Owner's contingency to cover minor or unforeseen items of work arising during construction. This allowance does not include errors or omissions by Contractor. Work shall be charged against this allowance only under the direction of the Architect with approval of Owner.

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1.04 QUANTITY ALLOWANCE SCHEDULE - BASE BID

- A. Quantity Allowances, General:
 - 1. Coordinate with Division 1 Section "Unit Prices" for unit price requirements that will be used to determine allowance adjustments.
 - 2. The following allowances shall be included in the Base Bid price on the Bid Proposal Form.
- B. Quantity Allowance No. 1: Include 20 cubic yards of soil removal and replacement with crushed stone.
- C. Quantity Allowance No. 2: Include 20 cubic yards of off site disposal of waste soil or rock.
- D. Quantity Allowance No. 3: Include 2,000 square feet of moisture vapor treatment (MVT).
- E. Quantity Allowance No. 4: Include 200 square feet of removal of deteriorated wall construction at fire walls/partitions and replacement with new rated assembly material. Coordinate with Division 1 "Unit Prices" for unit price requirements that will be used to determine allowance adjustments.

1.05 QUANTITY ALLOWANCE SCHEDULE - ALTERNATE NO. 6 (ROOF WORK)

- A. Quantity Allowances, General:
 - 1. Coordinate with Division 1 Section "Unit Prices" for unit price requirements that will be used to determine allowance adjustments.
 - 2. The following quantity allowances shall be included in the Alternate No. 6 price on the Bid Proposal Form.
- B. Quantity Allowance No. 5: Include 2,000 square feet of removal and replacement of Pre-Fabricated Insulated Pavers. Refer to Section 072216 "Roof Board Insulation."
- C. Quantity Allowance No. 6: Include 300 square feet of preparation of metal substrates and application of rust inhibitor coating, primer, and two coats of paint to rusted exposed steel components. Refer to Section 070152 "Preparation for Fluid-Applied Roofing."
- D. Quantity Allowance No. 7: Include 500 square feet of removal of deteriorated modified bitumen roofing membrane(s), down to the gypsum coverboard, and furnish and installation of new 2-ply torch applied modified bitumen membrane.
- E. Quantity Allowance No. 8: Include 500 square feet of removal of deteriorated 1/2-inch gypsum coverboard, and furnish and installation of new 1/2-inch thick gypsum coverboard.
- F. Quantity Allowance No. 9: Include 500 square feet of removal of deteriorated 1 inch polyisocyanurate insulation and furnish and installation of 1 inch of new polyisocyanurate insulation.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 012100

**SECTION 012200
UNIT PRICES**

PART 1 GENERAL

1.01 COSTS INCLUDED

- A. Unit Prices included on the Bid Form shall include full compensation for all required labor, products, tools, equipment, plant, transportation, services and incidentals; erection, application or installation of an item of the Work; overhead and profit.

1.02 UNIT QUANTITIES SPECIFIED

- A. Quantities indicated in the Bid Form are for bidding and contract purposes only. Quantities and measurements of actual Work will determine the payment amount.

1.03 MEASUREMENT OF QUANTITIES

- A. Measurement methods delineated on the Drawings or in the individual specification sections complement the criteria of this section. In the event of conflict, the requirements of the Drawings or individual specification section govern.
- B. Take all measurements and compute quantities. Measurements and quantities will be verified via mutual agreement, and by personnel authorized by Owner, if required.
- C. Assist by providing necessary equipment, workers, and survey personnel as required.
- D. Perform surveys required to determine quantities, including control surveys to establish measurement reference lines. Notify Architect prior to starting work.
- E. Contractor's Engineer Responsibilities: Sign surveyor's field notes or keep duplicate field notes; calculate and certify quantities for payment purposes.

1.04 PAYMENT

- A. Payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities of Work that is incorporated in or made necessary by the Work and accepted by the Architect, multiplied by the unit price.
- B. Payment will not be made for any of the following:
 - 1. Products wasted or disposed of in a manner that is not acceptable.
 - 2. Products determined as unacceptable before or after placement.
 - 3. Products not completely unloaded from the transporting vehicle.
 - 4. Products placed beyond the lines and levels of the required Work.
 - 5. Products remaining on hand after completion of the Work.
 - 6. Loading, hauling, and disposing of rejected Products.

1.05 SCHEDULE OF UNIT PRICES

- A. Unit Price 1: Soil Removal and Replacement with Crushed Stone.
 - 1. Unit price shall cover removal of unsuitable soils over or beyond that required for the work shown on the drawings, and replacement with crushed stone material. Unit price shall be measured in cubic yards (cu. yd.).
- B. Unit Price 2: Off Site Disposal of Waste Soil or Rock.
 - 1. Unit price shall cover transportation of waste soil or rock to off-site disposal. Unit price shall be measured in cubic yards (cu. yd.).

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- C. Unit Price 3: Moisture Vapor Treatment (MVT):
1. Unit Price shall cover providing a surface-applied moisture vapor treatment, to be applied to concrete slabs prior to installation of floor finishes. Unit price shall be measured by the square foot (sq. ft.). This unit price shall be provided in coordination with Quantity Allowance; refer to Allowances section for more information.
- D. Unit Price 4: Patching/Repair of Fire Walls/Partitions.
1. Unit price shall cover removal of deteriorated wall materials and replacement with new fire rated assembly. Unit price shall be measured by square foot (sq. ft.).
- E. Unit Price 5: Removal and Replacement of Insulated Roof Pavers:
1. Unit Price shall cover removal of existing insulated roof pavers and installation of new insulated roof pavers. Unit price shall be measured by the square foot (sq. ft.). This unit price shall be provided in coordination with Quantity Allowance; refer to Allowances section for more information.
- F. Unit Price 6: Treatment and Finish of Rusted Steel Components:
1. Unit Price shall cover preparation of metal substrate, followed by application of a rust inhibitor coating, followed by one coat of primer and two coats of finish paint to rusted exposed steel components. Unit price shall be measured by the square foot (sq. ft.). This unit price shall be provided in coordination with Quantity Allowance; refer to Allowances section for more information.
- G. Unit Price 7: Removal and Replacement of Modified Bitumen Roofing Membrane(s).
1. Unit price shall cover removal of existing deteriorated modified bitumen roofing membrane(s), down to the existing gypsum based coverboard, and installation of new modified bitumen membranes over suitable cover board surface in accordance with Division 07 roofing specifications. Unit price shall be measured by the square foot (sq. ft.). This unit price shall be provided in coordination with Quantity Allowance; refer to Allowances section for more information.
- H. Unit Price 8: Removal and Replacement of Gypsum Coverboard.
1. Unit price shall cover removal of existing 1/2-inch thick gypsum based coverboard, down to the existing polyiso insulation, and installation of new gypsum based cover board over suitable insulation surface in accordance with Division 07 roofing specifications. Unit price shall be measured by the square foot (sq. ft.). This unit price shall be provided in coordination with Quantity Allowance; refer to Allowances section for more information.
- I. Unit Price 9: Removal and Replacement of Polyiso Roof Insulation.
1. Unit price shall cover removal of existing deteriorated polyisocyanurate board roofing insulation, down to the existing substrate board or metal roof deck as applicable, and installation of new polyiso insulation over suitable substrate board/deck surface. Unit price shall be measured by the square foot (sq. ft.). This unit price shall be provided in coordination with Quantity Allowance; refer to Allowances section for more information.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 012200

**SECTION 012300
ALTERNATES**

PART 1 GENERAL

1.01 ACCEPTANCE OF ALTERNATES

- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in the Owner-Contractor Agreement.
- B. Coordinate related work and modify surrounding work to integrate the Work of each Alternate.
- C. Owner-Preferred Brands: Where Owner-Preferred Brands are indicated, the dollar amount for the alternate shall be the difference in cost between the Owner-Preferred Brand and the Base-Bid brand proposed by bidding Contractor. If the brand proposed by bidding Contractor is also the Owner-Preferred Brand, place "0" in the alternate amount.

1.02 SCHEDULE OF ALTERNATES

- A. Alternate No. 1: Provide polished concrete in spaces indicated.
 - 1. Base Bid Item: Provide polished concrete (CONC-POL) as indicated in the Drawings and per specification section 033543 "Polished Concrete Finishing".
 - 2. Alternate Item: State an alternate price, including all equipment, material, and labor, to provide sealed concrete (CONC-SLR) in lieu of polished concrete (CONC-POL) as indicated in the Drawings and per specification section 033000 "Cast-in-Place Concrete".
- B. Alternate No. 2: Owner-Preferred Brand - Electronic Plumbing Control. Coordinate with Division 22 and Plumbing Drawings.
 - 1. Base Bid Item: Provide electronic plumbing control system by any approved brand.
 - 2. Alternate Item: Provide electronic plumbing control system by I-CON.
- C. Alternate No. 3: Removal and Replacement of Site Lighting.
 - 1. Base Bid Item: Existing site lighting to remain.
 - 2. Alternate Item: Remove and replace site pole lights.
- D. Alternate No. 4: Owner-Preferred Brand - Airteq Security Locks.
 - 1. Base Bid Item: Provide security locks by any approved brand.
 - 2. Alternate Item: Provide security locks by Airteq.
- E. Alternate No. 5: Owner-Preferred Brand - Tyco Raven sprinkler heads.
 - 1. Base Bid Item: Provide sprinkler heads by any approved brand.
 - 2. Alternate Item: Provide sprinkler heads by Tyco Raven.
- F. Alternate No. 6: Re-Roofing of Building Sectors B & C. Note: Alternate No. 6 price shall include quantity allowances related to roofing work. Refer to Division 1 Sections "Allowances" and "Unit Prices."
 - 1. Base Bid Item: Existing roof to remain; no work on roof in Sectors B & C.
 - 2. Alternate Item: Re-roof Sectors B & C, in accordance with roofing drawings ("R" Series) and specifications. General re-roofing scope shall include the following:
 - a. Remove the sheet metal at rake edges and salvage for reinstallation.
 - b. Remove the perforated sheet metal paver securement at the rake edges and the gutter edges and salvage for reinstallation.
 - c. Remove the existing insulated pavers. Salvage insulated pavers in good condition and store for reinstallation..

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- d. Remove and dispose of loose granules, loose membrane and all debris from the surface of the existing modified bitumen/built-up roof membrane.
 - e. Conduct infrared scan of roof areas and document locations of any wet insulation.
 - f. Remove and replace any wet insulation detected by the infrared scan of the roof areas.
 - g. Provide new fluid-applied fully fabric reinforced roof membrane system and sheet metal flashings and accessories required for a complete, watertight, 20-year warrantable roof assembly.
 - h. Reinstall the salvaged insulated pavers and new insulated pavers over the entire surface of the fluid-applied fully fabric reinforced roof membrane system.
 - i. Reinstall the salvaged perforated sheet metal paver securement at the rake edges and the gutter edges.
 - j. Reinstall the sheet metal at rake edges.
- G. Alternate No. 7: Owner-Preferred Brand - Notifier fire alarm.
- 1. Base Bid Item: Provide fire alarm by any approved brand.
 - 2. Alternate Item: Provide fire alarm by Notifier.
- H. Alternate No. 8: Owner-Preferred Brand - Schneider Building Management System (BMS).
- 1. Base Bid Item: Provide Building Management System by any approved brand.
 - 2. Alternate Item: Provide Building Management System by Schneider.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 012300

**SECTION 012500
SUBSTITUTION PROCEDURES**

PART 1 GENERAL

1.01 DEFINITIONS

- A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.
 - 1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control, such as unavailability, regulatory changes, or unobtainable warranty terms.
 - 2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
 - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
 - 2. Agrees to provide the same warranty for the substitution as for the specified product.
 - 3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
 - 4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
 - 5. Waives claims for additional costs or time extension that may subsequently become apparent.
 - 6. Agrees to reimburse Owner and Architect for review or redesign services associated with re-approval by authorities.
- B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
 - 1. Note explicitly any non-compliant characteristics.
- C. Substitutions shall be submitted directly by a General Contractor/prime bidder. Substitutions submitted by a subcontractor, manufacturer, supplier or other entity other than General Contractor are not acceptable and shall be rejected.
- D. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
 - 1. A copy of the Substitution Request Form that shall be used is included at the end of this Section for informational purposes. Request a Word or editable PDF version of the form from the Architect and complete the form digitally; do not complete the form by hand.
 - 2. Contractor's Substitution Request documentation must include the following:
 - a. Substitution Request Information:
 - 1) Indication of whether the substitution is for cause or convenience.
 - 2) Issue date.

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- 3) Reference to particular Contract Document(s) specification section number, title, and article/paragraph(s).
- 4) Description of Substitution.
- 5) Reason why the specified item cannot be provided.
- 6) Description of how proposed substitution affects other parts of work.
- b. Attached Comparative Data: Provide point-by-point, side-by-side comparison addressing essential attributes specified, as appropriate and relevant for the item:
 - 1) Physical characteristics.
 - 2) In-service performance.
 - 3) Expected durability.
 - 4) Visual effect.
 - 5) Sustainable design features.
 - 6) Warranties.
 - 7) Other salient features and requirements.
 - 8) Include, as appropriate or requested, the following types of documentation:
 - (a) Product Data:
 - (b) Samples.
 - (c) Certificates, test, reports or similar qualification data.
 - (d) Drawings, when required to show impact on adjacent construction elements.
- c. Impact of Substitution: Provide data indicating cost savings to Owner and change in Contract Time due to accepting substitution.
- E. Limit each request to a single proposed substitution item.
 1. Submit an electronic document, combining the request form with supporting data into single document.

3.02 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

- A. Architect will consider requests for substitutions for convenience only within 30 days after date of Agreement.
 1. Substitutions for convenience submitted after this time period may or may not be considered, at the Architect's discretion.
- B. Submit request for Substitution for Cause immediately upon discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
- C. Submit request for Substitution for Convenience immediately upon discovery of its potential advantage to the project, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
 1. In addition to meeting general documentation requirements, document how the requested substitution benefits the Owner through cost savings, time savings, greater energy conservation, or in other specific ways.
 2. Document means of coordinating of substitution item with other portions of the work, including work by affected subcontractors.
 3. Bear the costs engendered by proposed substitution of:
 - a. Owner's compensation to the Architect for any required redesign, time spent processing and evaluating the request.
 - b. Other unanticipated project considerations.

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- D. Substitutions will not be considered under one or more of the following circumstances:
 - 1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
 - 2. Without a separate written request.

3.03 RESOLUTION

- A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.
- B. Architect will notify Contractor in writing of decision to accept or reject request.

3.04 ACCEPTANCE

- A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

3.05 CLOSEOUT ACTIVITIES

- A. See Section 017800 - Closeout Submittals, for closeout submittals.

END OF SECTION 012500

Substitution Request Form – Prior to Receipt of Bids

General Information				
Project Name	Detention Annex Renovation - Wake County, North Carolina			
A/E Project Number	642088			
Specified Product/Item Information				
Specification Title				
Section				
Page				
Article / Paragraph				
Description				
Proposed Substitution Information				
Proposed Substitution				
Reason for not providing specified product/item				
Comparative Data	Attach a point-by-point comparative data list. Include all differences between the proposed substitution and the specified product/item. If not provided, this Request will be rejected.			
Manufacturer				
Manufacturer Address				
Manufacturer Phone				
Manufacturer Representative Email address				
Trade / Model Name				
Model Number				
Installer (if known)				
Installer Address				
Installer Phone				
History	☐ New product	☐ 2-5 years	☐ 5-10 yrs	☐ 10 yrs or longer
Proposed substitution affects other parts of the Work	☐ Yes		☐ No	
If yes, explain				
Proposed Substitution Similar Installation				
Have you used this product/item on any other projects	☐ Yes		☐ No	
Project				
Project Address				
Architect/Engineer				
A/E Phone				

Owner					
Owner Phone					
Date installed					
Attached Supporting Data					
☐ Drawings	☐ Product Data/Specs	☐ Samples	☐ Tests	☐ Reports	☐
Entity submitting this Substitution Request certifies all of the following:					
- Proposed substitution has been fully investigated and determined to be equivalent or superior in all respects to the specified product, except as may otherwise be specifically and clearly indicated herein. - If applicable, proposed substitution shall not adversely affect LEED requirements nor shall it prevent achieving the relative number of applicable LEED point[s] the specified product would have received. - Proposed substitution's function, appearance, and quality are equal or superior in all respects to the specified product, except as may otherwise be specifically and clearly indicated herein. - Same or superior warranty and/or guarantees shall be furnished for proposed substitution as is required for the specified product/item. - Same maintenance service and source replacement parts, as applicable, are available; including local availability. - Proposed substitution shall have no adverse effect on other trades. - Proposed substitution shall not affect dimensions and functional clearances. - Coordination, installation, and changes to the Work as necessary for the accepted proposed substitution shall be complete in all respects.					
Entity's Information					
Submitted by					
Signed By					
Date					
Email address of Signee above					
Company Name					
Address					
Phone					
Architect / Engineer Review and Action					
If this Substitution request is acceptable, it shall be included in an Addendum. If the proposed substitution is not included in an Addendum, then the proposed substitution was rejected; was not submitted in accordance with the Bidding/Procurement Documents; and/or this Form was not complete. This Form shall be completely filled in to be considered for acceptance. Acceptance of this Substitution request is an acceptance of the manufacturer and product/item only for general conformance with the design concept reflected in the Bidding/Procurement Documents. The A/E has made no attempt to verify specific performance data, or to check details of the proposed substitution as to special features, capacities, physical dimensions, or code and/or regulatory compliance – all of which remain the responsibility of the submitting entity and the Contractor (if not the submitting entity).					

END OF SUBSTITUTION REQUEST FORM

**SECTION 013000
ADMINISTRATIVE REQUIREMENTS**

PART 1 GENERAL

1.01 GENERAL ADMINISTRATIVE REQUIREMENTS

- A. Comply with requirements of Section 017000 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.
- B. Electronic File Distribution: Upon request, Contractor may be provided electronic files for use in coordination of the Work and preparation of submittals. Contractor shall submit a signed Request Form for Electronic Files, provided by the Architect.
 - 1. Electronic files do not contain all of the information of the Bid Documents or Contract Documents for construction of the Project, and the Architect shall not be responsible for differences between electronic files, Bid Documents, and Contract Documents.

1.02 SUBMITTALS

- A. General Contractor Personnel: Within 15 days after award of Contract, provide a summary of General Contractor's on site personnel. Identify each individual, beginning with project superintendent. List project responsibilities, cell phone number, and email address.
- B. Subcontractors: Within 15 days after award of Contract, provide a summary of all companies and individuals engaged as subcontractors for any part of the Project. Include a contact name, company address, phone number, and email address, and identify what part of the Work shall be completed by each subcontractor.
- C. Coordination Drawings: Submit completed Coordination Drawings for Architect's information.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 ELECTRONIC DOCUMENT SUBMITTAL SERVICE

- A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF, MS Word, or MS Excel) format, as appropriate to the document, and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.
 - 1. Besides submittals for review, information, and closeout, this procedure applies to Requests for Interpretation (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
 - 2. It is Contractor's responsibility to submit documents in allowable format.
 - 3. Subcontractors, suppliers, and Architect's consultants will be permitted to use the service at no extra charge.
 - 4. Paper document transmittals will not be reviewed unless previously approved; emailed electronic documents will not be reviewed.
 - 5. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.

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- B. Submittal Service: Coordinate method for exchanging files no later than the Preconstruction Meeting. The Architect's Procore service and procedures can be used at no charge. If the Contractor chooses to use a different platform and methodology:
 - 1. The Architect may reject the methodology or platform proposed and:
 - a. use the Architect's Procore service, or
 - b. the project team will revert to traditional hard-copy exchange;
 - 2. or the Contractor shall bear the cost of software, licensing, training, etc., for the project team to participate.
- C. Project Closeout: Architect will determine when to terminate the service for the project and is responsible for obtaining archive/record copies of files for Owner. If the Project Team uses an alternate platform preferred by the Contractor, the Contractor shall be responsible for distributing archive/record copies of files to Owner and Architect.

3.02 PRECONSTRUCTION MEETING

- A. Architect will schedule a meeting after Notice of Award.
- B. Attendance Required:
 - 1. Owner.
 - 2. Architect.
 - 3. Contractor.
 - 4. Owner's Commissioning Agent.
 - 5. Major subcontractors, consultants, and others as necessary and appropriate.
- C. Agenda:
 - 1. Execution of Owner-Contractor Agreement.
 - 2. Submission of executed bonds and insurance certificates.
 - 3. Distribution of Contract Documents.
 - 4. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
 - 5. Designation of personnel representing the parties to Contract and Architect.
 - 6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
 - 7. Scheduling.
 - 8. Site mobilization and utilization.
 - 9. Other project-specific items on pre-distributed agenda.
- D. Architect shall record minutes and distribute digital copies to Owner, Contractor, and other attendees. Contractor shall be responsible for distribution to subcontractors and other personnel affected by decisions made.

3.03 INDOOR AIR QUALITY (IAQ) MANAGEMENT PLAN DEVELOPMENT SESSION

- A. Architect will schedule a meeting after Notice of Award.
 - B. Attendance Required:
 - 1. Owner.
 - 2. Owner's Commissioning Agent.
 - 3. Architect.
 - 4. Mechanical engineer.
 - 5. Contractor.
-

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6. HVAC subcontractor.
 7. Other major subcontractors, consultants, and others as necessary and appropriate.
- C. Agenda:
1. Protection of Materials: Discussion of how and where materials that could impact IAQ will be stored, including but not limited to, the following:
 - a. Insulation.
 - b. Gypsum board.
 - c. Flooring materials.
 - d. Ceiling panels.
 - e. Furnishings.
 - f. Odorous chemicals.
 2. Protection of HVAC: Discussion of how HVAC equipment will be stored installed, and operated during construction.
 3. Pathway Interruption: Discussion of how airflow between construction zones will be limited to prevent the spreading of pollutants from one part of the building to another.
 4. Housekeeping: Discussion of how the building will be kept clean and dry.
 5. Materials Installation Scheduling: Discussion of what wet (odor emitting) materials will be used on the project, in order to schedule their installation before fuzzy (odor absorbing) materials.

3.04 PREINSTALLATION MEETINGS

- A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section. Do not allow installation of affected work to proceed until preinstallation meeting can be held.
 1. Include all preinstallation meetings on the Project Schedule.
- B. Require attendance of parties directly affecting, or affected by, work of the specific section.
- C. Notify Architect and Owner in advance of meeting date.
- D. Prepare agenda and preside at meeting:
 1. Review conditions of examination, preparation and installation procedures.
 2. Review coordination with related work.
- E. Record minutes and distribute copies within two days after meeting to participants, with copies to Architect, Owner, participants, and those affected by decisions made.

3.05 PROGRESS MEETINGS

- A. Architect will make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
 - B. Attendance Required:
 1. Owner.
 2. Architect.
 3. Contractor's superintendent.
 4. Other subcontractors or consultants as required for the specific parts of the Work to be discussed.
 - C. Agenda:
 1. Review minutes of previous meetings.
 2. Review of work progress.
-

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3. Field observations, problems, and decisions.
 4. Identification of problems that impede, or will impede, planned progress.
 5. Review of submittals schedule and status of submittals.
 6. Review of RFIs log and status of responses.
 7. Maintenance of progress schedule.
 8. Corrective measures to regain projected schedules.
 9. Planned progress during succeeding work period.
 10. Maintenance of quality and work standards.
 11. Effect of proposed changes on progress schedule and coordination.
 12. Other business relating to the work.
- D. Architect shall record minutes and distribute copies to the Owner, Contractor, and other consultants, Owner's representatives, or other third party attendees. The Contractor shall be responsible for distributing to any affected subcontractors and other personnel.

3.06 CLOSEOUT MEETING

- A. Schedule and administer closeout meeting no later than 90 days before the scheduled Date of Substantial Completion.
- B. Make arrangements for the meeting, prepare agenda with copies for participants, and preside at the meeting.
- C. Attendance Required:
1. Owner.
 2. Architect.
 3. Contractor's superintendent.
 4. Major subcontractors.
 5. Other subcontractors or consultants as required.
- D. Agenda:
1. Review closeout requirements and procedures in Division 1 Section "Execution and Closeout Requirements."
 2. Review startup, testing, and adjusting of all systems, including testing/adjusting/balancing (TAB) and Commissioning.
 3. Coordination of inspections by local authorities having jurisdiction and third party Special Inspectors as required to obtain Certificate of Occupancy.
 4. Coordination of Owner's occupancy and changeover of utilities, insurance, and building keying/lock system.
 5. Procedures for Contractor's Correction Punch List, Architect's Substantial Completion inspection, and Final Correction Punch List.
 6. Delivery, turnover, and storage of maintenance materials, attic stock, special tools, and other non-installed materials.
 7. Coordination of closeout documentation, including demonstration and training materials and videos, as built/record documents, operation and maintenance binders, and warranty binders.
 8. Removal of temporary facilities, construction equipment, and tools.
 9. Final cleaning, touchup, restoration, and preventive maintenance.
 10. Coordination of final Applications for Payment.

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- E. Record minutes and distribute copies within two days after meeting to participants, with copies to Architect, Owner, participants, and those affected by decisions made.

3.07 DAILY CONSTRUCTION REPORTS

- A. Include only factual information. Do not include personal remarks or opinions regarding operations and/or personnel.
- B. Prepare a daily construction report recording the following information concerning events at Project site and project progress:
 - 1. Date.
 - 2. High and low temperatures, and general weather conditions.
 - 3. List of subcontractors at Project site.
 - 4. Approximate count of personnel at Project site.
 - 5. Major equipment at Project site.
 - 6. Material deliveries.
 - 7. Safety, environmental, or industrial relations incidents.
 - 8. Meetings and significant decisions.
 - 9. Unusual events (submit a separate special report).
 - 10. Stoppages, delays, shortages, and losses. Include comparison between scheduled work activities (in Contractor's most recently updated and published schedule) and actual activities. Explain differences, if any. Note days or periods when no work was in progress and explain the reasons why.
 - 11. Directives and requests of Authority(s) Having Jurisdiction (AHJ).
 - 12. Testing and/or inspections performed.
 - 13. Signature of Contractor's authorized representative.

3.08 COORDINATION DRAWINGS AND COORDINATION CONFERENCE

- A. Coordination Drawings: The Contractor shall prepare coordination drawings of all spaces where utilities, systems, and other components converge or intersect and efficient installation is required to accommodate all components.
 - 1. Prepare coordination drawings of the following spaces, at minimum. Supplement with additional spaces as required by project-specific conditions.
 - a. Above ceilings.
 - b. Vertical chases, shafts, and wall cavities.
 - c. Mechanical and electrical rooms, fire pump room, and other major utility spaces.
 - 2. Provide accurate overall dimensions of components (for example, outside diameters of pipe and conduit, or overall ductwork dimensions including insulation and enclosure thickness).
 - 3. Include accessory components of systems that could cause potential conflicts, such as bracing, slotted channel framing, hangers, and other supports, valve handles, flanges, fittings, cable/wire management trays, and other similar components.
 - 4. Include sequence of installation of all components, materials, and systems.
 - 5. Include means of access to each component, material, or system, for maintenance and repairs.
 - 6. Provide additional coordination drawings as required by individual specification sections.
 - 7. Prepare Coordination Drawings using project-specific information. Do not use photocopies or reproductions of Contract Documents, and do not use standard details or data from manufacturers, suppliers, or other outside parties.

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8. Drawing Files: The Contractor may develop coordination drawings using 2D CAD software or with 3D BIM software with clash-detection functionality.
 - a. The Architect will furnish original 3D BIM model or 2D DWG files for Contractor's use upon receipt of Architect's "Request Form for Electronic Files". A copy of this form shall be provided to the Contractor upon request.
 - 1) The Architect makes no guarantee to the accuracy of components in electronic files. The Contractor shall coordinate electronic data with the Contract Documents in order to provide final Coordination Drawings.
 - 2) If using 2D files, the Contractor shall prepare drawings in multiple views (for example, RCP and section) to fully represent 3D space, for example plenum heights, wall assembly thicknesses, etc.
9. Submittal: Submit Coordination Drawings as a "Submittal for Information." Architect will not approve Coordination Drawings, but will keep on file for use in subsequent coordination and conflict resolution.
- B. Coordination Conference: Schedule and conduct a Coordination Conference prior to beginning construction or rough-in of affected work. Require attendance by all affected trades and installers.
 1. Identify the Coordination Conference as a "milestone" date on the Construction Progress Schedule.
 2. Advise the Architect of all potential conflicts identified in the Coordination Drawings and at the Coordination Conference.
 3. Do not proceed with construction or installation of components, materials, or systems until potential conflicts have been resolved and affected parties have agreed to a remedy.
 4. Remedies to address conflicts not identified in the Coordination Drawings, at the Coordination Conference, or otherwise addressed prior to construction or installation of affected components, materials, and systems, or discovery of a non-workable situation not identified or addressed, will not be considered as a basis for delay, time extension, or additional cost to the Contract.

3.09 REQUESTS FOR INFORMATION (RFI)

- A. Definition: A request seeking one of the following:
 1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in Contract Documents.
 2. A resolution to an issue which has arisen due to field conditions and affects design intent.
- B. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
 1. Prepare a separate RFI for each specific item.
 - a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
 - b. Do not forward requests which solely require internal coordination between subcontractors.
 2. Prepare in a format and with content acceptable to Owner.
 3. Prepare using software provided by the Electronic Document Submittal Service.
 4. Combine RFI and its attachments into a single electronic file. PDF format is preferred.

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- C. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is not included.
 - 1. Include in each request Contractor's signature attesting to good faith effort to determine from Contract Documents information requiring interpretation.
 - 2. Unacceptable Uses for RFIs: Do not use RFIs to request the following:
 - a. Approval of submittals (use procedures specified elsewhere in this section).
 - b. Approval of substitutions (see Section - 016000 - Product Requirements)
 - c. Changes that entail change in Contract Time and Contract Sum (comply with provisions of the Conditions of the Contract).
 - d. Different methods of performing work than those indicated in the Contract Drawings and Specifications (comply with provisions of the Conditions of the Contract).
 - 3. Improper RFIs: Requests not prepared in compliance with requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response.
 - 4. Frivolous RFIs: Requests regarding information that is clearly indicated on, or reasonably inferable from, Contract Documents, with no additional input required to clarify the question. They will be returned without a response.
 - a. The Owner reserves the right to assess the Contractor for the costs (on time-and-materials basis) incurred by the Architect, and any of its consultants, due to processing of such RFIs.
- D. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.
 - 1. Official Project name and number, and any additional required identifiers established in Contract Documents.
 - 2. Owner's, Architect's, and Contractor's names.
 - 3. Discrete and consecutive RFI number, and descriptive subject/title.
 - 4. Issue date and requested reply date.
 - 5. Reference to particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
 - 6. Annotations: Field dimensions and/or description of conditions which have engendered the request.
 - 7. Contractor's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example; routing, clearances, and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.
- E. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.
- F. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.
 - 1. Indicate current status of every RFI. Update log promptly and on a regular basis.
 - 2. Note dates of when each request is made, and when a response is received.
- G. Review Time: Architect will respond and return RFIs to Contractor within seven calendar days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 12:00 noon will be considered as having been received on the following regular working day.

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1. Response period may be shortened or lengthened for specific items, subject to mutual agreement.
- H. Responses: Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If in Contractor's belief it is likely to lead to a change to Contract Sum or Contract Time, promptly issue a notice to this effect, and follow up with an appropriate Change Order request to Owner.
 1. When the Architect provides a response to an RFI, that RFI shall be closed. If there is additional information required, or a question about the response itself, then another RFI with a new number shall be generated by the Contractor. At no time shall an RFI be "re-opened" or remain open after the Architect has formally responded.
 2. Do not extend applicability of a response to specific item to encompass other similar conditions, unless specifically so noted in the response.
 3. Upon receipt of a response, promptly review and distribute it to all affected parties, and update the RFI Log.
 4. Notify Architect within seven calendar days if an additional or corrected response is required by submitting an amended version of the original RFI, identified as specified above.

3.10 SUBMITTAL SCHEDULE

- A. Submit to Architect for review a schedule for submittals in tabular format.
 1. Coordinate with Contractor's construction schedule and schedule of values.
 2. Format schedule to allow tracking of status of submittals throughout duration of construction.
 3. Arrange information to include scheduled date for initial submittal, specification number and title, submittal category (for review or for information), description of item of work covered, and role and name of subcontractor.
 4. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates.
 - a. For assemblies, equipment, systems comprised of multiple components and/or requiring detailed coordination with other work, allow for additional time to make corrections or revisions to initial submittals, and time for their review.
 - b. Account for a reasonable duration of time to allow for final color selections, approvals, and preparation of final finish schedules (one finish schedule for interior color selections, and one for exterior color selections). This period shall begin upon receipt of all submittals requiring color selection.

3.11 SUBMITTALS FOR REVIEW

- A. When the following are specified in individual sections, submit them for review:
 1. Product data.
 2. Design data.
 3. Shop drawings.
 4. Samples for selection.
 5. Samples for verification.
- B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.
- C. Samples will be reviewed for aesthetic, color, or finish selection.

- D. Color Selection: In individual specification sections, specific items are identified which require color/finish selections to be made by the Architect from color chart or sample submittals. The Submittal Schedule, prepared according to "Submittal Schedule" paragraph above, shall identify these required color/finish submittals.
 - 1. Submittals requiring color selection must be submitted by Contractor and approved by Architect for conformance with Contract Documents prior to the start of the color selection process. When the submittals have been approved for conformance with Contract Documents, the process for color selection, presentation of color concepts, Owner approval, and Color Schedule preparation will begin.
 - 2. Interior Color Selections: The Architect will make coordinated selections of colors/finishes for the building interior, present the resulting color concepts to the Owner for approval, and prepare the actual Interior Color Schedule for the Work.
 - 3. Exterior Color Selections: The Architect will make coordinated selections of colors/finishes for the building exterior and prepare Exterior Color Schedule.
- E. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below.

3.12 SUBMITTALS FOR INFORMATION

- A. When the following are specified in individual sections, submit them for information:
 - 1. Certificates.
 - 2. Test reports.
 - 3. Inspection reports.
 - 4. Manufacturer's instructions.
 - 5. Manufacturer's field reports.
 - 6. Other types indicated.
- B. Submit for Architect's knowledge as contract administrator or for Owner.

3.13 SUBMITTALS FOR PROJECT CLOSEOUT

- A. Submit Correction Punch List for Substantial Completion.
- B. Submit Final Correction Punch List for Substantial Completion.
- C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 017800 - Closeout Submittals:
 - 1. Project record documents.
 - 2. Operation and maintenance data.
 - 3. Warranties.
 - 4. Bonds.
 - 5. Other types as indicated.

3.14 NUMBER OF COPIES OF SUBMITTALS

- A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.
- B. Selection Samples: Submit one set of manufacturer's charts indicating full range of available colors, textures, patterns, and other aesthetic qualities.
- C. Verification Samples: Submit three sets of physical samples. Two sets will be retained by Architect, the third will be returned to the Contractor. Maintain approved sample at the Project site for use in comparing to installed Work.

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1. Where a full-size assembly of multiple components is required as a sample (for example, railing section or full-size cabinet), only one sample is required for those items.

3.15 SUBMITTAL PROCEDURES

A. General Requirements:

1. Use a single transmittal for all submittals required by each individual specification section, unless otherwise indicated.
 - a. Verification samples and large shop drawing submittals may be submitted under separate cover when approved by Architect.
2. Transmit using AIA G810 or other approved form.
3. Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.
4. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
5. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
 - a. Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.
6. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties, and is of the benefit to the project.
 - a. Upload submittals in electronic form to Electronic Document Submittal Service website.
7. Schedule submittals to expedite the Project, and coordinate submission of related items.
 - a. Allow sufficient time for administrative processing, Architect's initial review, and potential resubmittals.
 - 1) Large submittals may require longer review durations. Large or multi-part submittals (such as structural steel or aluminum storefront and curtainwall) may be submitted by building area, building level, or otherwise subdivided "packages" with the approval of the Architect. Subdivided "packages" will be reviewed one at a time in the order received. If large submittals are submitted in their entirety as a single package, the Architect may elect to review and return portions of the submittal individually, and will coordinate the schedule for return of these partial reviews with the Contractor for sequencing in the Work.
 - b. Allow additional time for submittals requiring sequential reviews involving Architect's consultants, Owner, or another affected party.
 - c. Allow additional time for submittals requiring sequential reviews involving approval from authorities having jurisdiction (AHJ), in addition to Architect's approval.
 - d. No extensions to the project schedule shall be granted due to delays that can be attributed to submittal processing or failure to allow for sequential reviews or resubmittals.
8. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
9. When revised for resubmission, identify all changes made since previous submission.
10. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
11. Incomplete submittals may not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.

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12. Submittals not requested will be recognized, and will be returned "Not Reviewed".
- B. Product Data Procedures:
 1. Submit only information required by individual specification sections.
 2. Collect required information into a single submittal.
 3. Submit concurrently with related shop drawing submittal.
 4. Do not submit (Material) Safety Data Sheets for materials or products.
- C. Shop Drawing Procedures:
 1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
 2. Do not reproduce Contract Documents to create shop drawings.
 3. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.
- D. Samples Procedures:
 1. Transmit related items together as single package.
 2. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.
 3. Selection Samples: Provide color charts that accurately relay color, pattern, and texture information. Photographs or photocopies of color charts are unacceptable and subject to rejection.
 4. Verification Samples: Provide physical samples of each color selected by Architect from Selection Samples. Verification samples shall be manufactured and prepared identically to the material that shall be used in the installed Work. Label each sample clearly with manufacturer, product name, and color, texture, and/or pattern name as applicable. Photographs of physical samples are unacceptable and subject to rejection.

3.16 SUBMITTAL REVIEW

- A. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.
- B. Submittals for Information: Architect will acknowledge receipt, but will take no other action.
- C. Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.
 1. Notations may be made directly on submitted items and/or listed on appended Submittal Review cover sheet.
- D. Architect's actions on items submitted for review:
 1. Authorizing purchasing, fabrication, delivery, and installation:
 - a. "Approved as Noted":
 - 1) Where review notations indicate revisions are necessary, submit corrected item, with review notations acknowledged and incorporated.
 2. Not Authorizing fabrication, delivery, and installation:
 - a. "Revise and Resubmit":
 - 1) Resubmit revised item, with review notations acknowledged and incorporated.
 - b. "Rejected/Resubmit":
 - 1) New submittal required, with item complying with requirements of Contract Documents.
 - c. "Color Selection Required":

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- 1) Color selections for the entire project, or portion thereof, will be provided after receipt of all color charts and samples required for the Project.
- d. "Not Submitted":
 - 1) Additional submittal items are required that were not provided in the original submittal.
- E. Architect's actions on items submitted for information:
 - 1. Items for which no action was taken:
 - a. "Not Reviewed": To notify the Contractor that the submittal has been received for record only.

END OF SECTION 013000

SECTION 013216
CONSTRUCTION PROGRESS SCHEDULE

PART 1 GENERAL

1.01 SUBMITTALS

- A. Within 10 days after date of Agreement, submit preliminary schedule defining planned operations for the first 60 days of Work, with a general outline for remainder of Work.
- B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
- C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
 - 1. Include written certification that major contractors have reviewed and accepted proposed schedule.
- D. Within 10 days after joint review, submit complete schedule.
- E. Submit updated schedule with each Application for Payment.
- F. Submit in PDF format.

1.02 QUALITY ASSURANCE

- A. Scheduler: Contractor's personnel or specialist Consultant specializing in CPM scheduling with experience in scheduling construction work of a complexity comparable to this Project, and having use of computer facilities capable of delivering a detailed graphic printout within 48 hours of request.

1.03 SCHEDULE FORMAT

- A. Listings: In chronological order according to the start date for each activity. Identify each activity with the applicable specification section number.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRELIMINARY SCHEDULE

- A. Prepare preliminary schedule in the form of a horizontal bar chart.

3.02 CONTENT

- A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.
- B. Identify work of separate phases and other logically grouped activities.
- C. Identify all major milestone dates, including, but not limited to, Notice to Proceed and Substantial and Final Completion dates.
- D. Identify duration of each activity, in maximum 15 day intervals.
- E. Incorporate work restrictions indicated in Section 011000 - Summary, if any.
- F. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.

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- G. Provide separate schedule of submittal dates for shop drawings, product data, and samples, owner-furnished products, products identified under Allowances, and dates reviewed submittals will be required from Architect. Indicate decision dates for selection of finishes.
- H. Indicate procurement duration and delivery dates for long-lead time items.
- I. Coordinate submittal approval process with procurement and delivery requirements. Submittals requiring resubmission or revision for approval will not be allowed as a basis for schedule impacts.
- J. Indicate delivery dates for owner-furnished products and products identified under Allowances.
- K. Indicate the time period for color selection activity and approval by Owner and Architect, as required per Section 013000 - Administrative Requirements.
- L. Indicate date of changeover from temporary to permanent utilities.
- M. Indicate time periods for Commissioning activities, equipment startup, and testing and balancing.
- N. Provide a reasonable time period prior to the date of Substantial Completion for administrative activities and procedures.
- O. Provide legend for symbols and abbreviations used.

3.03 BAR CHARTS

- A. Include a separate bar for each major portion of Work or operation.
- B. Identify critical path activities.
- C. Identify the first work day of each week.

3.04 NETWORK ANALYSIS (CPM)

- A. Prepare network analysis diagrams and supporting mathematical analyses using the Critical Path Method.
- B. Illustrate order and interdependence of activities and sequence of work; how start of a given activity depends on completion of preceding activities, and how completion of the activity may restrain start of subsequent activities.
- C. Mathematical Analysis: Tabulate each activity of detailed network diagrams, using calendar dates, and identify for each activity:
 - 1. Preceding and following event numbers.
 - 2. Activity description.
 - 3. Estimated duration of activity, in maximum 15 day intervals.
 - 4. Earliest start date.
 - 5. Earliest finish date.
 - 6. Actual start date.
 - 7. Actual finish date.
 - 8. Latest start date.
 - 9. Latest finish date.
 - 10. Total and free float; float time shall accrue to Owner and to Owner's benefit.
 - 11. Percentage of activity completed.
 - 12. Responsibility.
- D. Analysis Program: Capable of accepting revised completion dates, and recomputation of all dates and float.

- E. Required Reports: List activities in sorts or groups:
 - 1. By preceding work item or event number from lowest to highest.
 - 2. By amount of float, then in order of early start.
 - 3. In order of latest allowable finish dates.
 - 4. Listing of activities on the critical path.

3.05 REVIEW AND EVALUATION OF SCHEDULE

- A. Participate in joint review and evaluation of schedule with Architect at each submittal.
- B. Evaluate project status to determine work behind schedule and work ahead of schedule.
- C. After review, revise as necessary as result of review, and resubmit within 10 days.

3.06 UPDATING SCHEDULE

- A. Maintain schedules to record actual start and finish dates of completed activities.
- B. Indicate progress of each activity to date of revision, with projected completion date of each activity.
- C. Annotate diagrams to graphically depict current status of Work.
- D. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.
- E. Indicate changes required to maintain Date of Substantial Completion.
- F. Schedule revisions shall not modify any Contract Dates or the Contract Sum, unless specifically approved and documented via Change Order.
- G. Submit reports required to support recommended changes.
- H. Provide narrative report to define problem areas, anticipated delays, and impact on the schedule. Report corrective action taken or proposed and its effect.
- I. Recovery Schedule: If the Contractor is 14 or more days behind schedule, in the opinion of the Owner, the Contractor shall prepare a Recovery Schedule, incorporating a reasonable, mutually agreed upon length of time to return the Work to the approved Schedule. The Recovery Schedule shall be prepared to the same level of detail as the original construction progress schedule. Submit the recovery schedule for Owner review; do not proceed until the Owner has approved.
 - 1. At the end of the recovery period, Owner shall reevaluate construction progress and determine if the Recovery Schedule has been successfully completed. If completed, Owner shall direct the Contractor to proceed with the latest approved Construction Schedule.
 - a. If the Contractor is still behind schedule at the end of the recovery period, the Owner shall direct the Contractor to provide additional schedule revisions to complete the recovery, or may at its option pursue other means of resolution as provided for by the Contract Documents.
 - 2. Need for and preparation of a Recovery Plan shall not be the basis of additional cost to the Owner or extension of Project Schedule, unless the Contractor can demonstrate that the reason for being behind schedule is no fault of their own.

3.07 DISTRIBUTION OF SCHEDULE

- A. Distribute copies of updated schedules to Contractor's project site file, to subcontractors, suppliers, Architect, Owner, and other concerned parties.

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- B. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

END OF SECTION 013216

**SECTION 014000
QUALITY REQUIREMENTS**

PART 1 GENERAL

1.01 DEFINITIONS

- A. Contractor's Quality Control Plan: Contractor's management plan for executing the Contract for Construction.
- B. Contractor's Professional Design Services/Delegated Design: Design of some aspect or portion of the project by party other than the design professional of record. Provide these services as part of the Contract for Construction.
 - 1. Design Services Types Required:
 - a. Construction-Related: Services Contractor needs to provide in order to carry out the Contractor's sole responsibilities for construction means, methods, techniques, sequences, and procedures.
 - b. Design-Related: Design services explicitly required to be performed by another design professional due to highly-technical and/or specialized nature of a portion of the project. Services primarily involve engineering analysis, calculations, and design, and are not intended to alter the aesthetic aspects of the design.
- C. Design Data: Design-related, signed and sealed drawings, calculations, specifications, certifications, shop drawings and other submittals provided by Contractor, and prepared directly by, or under direct supervision of, appropriately licensed design professional.

1.02 CONTRACTOR'S CONSTRUCTION-RELATED PROFESSIONAL DESIGN SERVICES

- A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.
- B. Provide such engineering design services as may be necessary to plan and safely conduct certain construction operations, pertaining to, but not limited to the following:
 - 1. Temporary sheeting, shoring, or supports.
 - 2. Temporary scaffolding.
 - 3. Temporary bracing.
 - 4. Temporary falsework for support of spanning or arched structures.
 - 5. Temporary foundation underpinning.
 - 6. Temporary stairs or steps required for construction access only.
 - 7. Temporary hoist(s) and rigging.
 - 8. Investigation of soil conditions and design of temporary foundations to support construction equipment.
 - 9. Additional temporary controls as required.

1.03 CONTRACTOR'S DESIGN-RELATED PROFESSIONAL DESIGN SERVICES

- A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.
- B. Base design on performance and/or design criteria indicated in individual specification sections.
 - 1. Submit a Request for Information to Architect if the criteria indicated are not sufficient to perform required design services.
- C. Scope of Design Services/Delegated Design: As required by individual specification sections.

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1.04 SUBMITTALS

- A. Designer's Qualification Statement: Submit for Architect's knowledge as contract administrator, or for Owner's information.
 - 1. Include information for each individual professional responsible for producing, or supervising production of, design-related professional services provided by Contractor.
 - a. Full name.
 - b. Professional licensure information.
 - c. Statement addressing extent and depth of experience specifically relevant to design of items assigned to Contractor.
- B. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.
 - 1. Include calculations that have been used to demonstrate compliance to performance and regulatory criteria provided, and to determine design solutions.
 - 2. Include required product data and shop drawings.
 - 3. Include a statement or certification attesting that design data complies with criteria indicated, such as building codes, loads, functional, and similar engineering requirements.
 - 4. Include signature and seal of design professional responsible for allocated design services on calculations and drawings.
- C. Test Reports: After each test/inspection, require testing agency to promptly distribute digital copy of report to Architect, Owner, Contractor, and others as required.
 - 1. Include:
 - a. Date issued.
 - b. Project title and number.
 - c. Name of inspector.
 - d. Date and time of sampling or inspection.
 - e. Identification of product and specifications section.
 - f. Location in the Project.
 - g. Type of test/inspection.
 - h. Date of test/inspection.
 - i. Results of test/inspection.
 - j. Compliance with Contract Documents.
 - k. When requested by Architect, provide interpretation of results.
- D. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor to Architect, in quantities specified for Product Data.
 - 1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
 - 2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect.
- E. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
- F. Manufacturer's Field Reports:
 - 1. Submit report promptly to Architect for information.

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2. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.

1.05 QUALITY ASSURANCE

- A. Testing Agency Qualifications:
 1. Prior to start of work, submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
 2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
 3. Qualification Statement: Provide documentation showing testing laboratory is accredited under OSHA's Nationally Recognized Testing Laboratory (NRTL) program or through the National Institute of Standards and Technology's (NIST's) National Voluntary Laboratory Accreditation Program (NVLAP).
- B. Designer Qualifications: Where professional engineering design services and design data submittals are specifically required of Contractor by Contract Documents, provide services of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
- C. Contractor's Quality Control (CQC) Plan:
 1. Prior to start of work, submit a comprehensive plan describing how contract deliverables will be produced. Tailor CQC plan to specific requirements of the project. Include the following information:
 - a. Management Structure: Identify personnel responsible for quality. Include a chart showing lines of authority.
 - 1) Include qualifications (in resume form), duties, responsibilities of each person assigned to CQC function.
 - b. Management Approach: Define, describe, and include in the plan specific methodologies used in executing the work.
 - 1) Management and control of documents and records relating to quality.
 - 2) Communications.
 - 3) Coordination procedures.
 - 4) Resource management.
 - 5) Process control.
 - 6) Inspection and testing procedures and scheduling, including inspections by authorities having jurisdiction and special inspections.
 - 7) Control of noncomplying work.
 - 8) Tracking deficiencies from identification, through acceptable corrective action, and verification.
 - 9) Control of testing and measuring equipment.
 - 10) Project materials certification.
 - 11) Managerial continuity and flexibility.
 - c. Acceptance of the plan is required prior to start of construction activities not including mobilization work. Owner's acceptance of the plan will be conditional and predicated on continuing satisfactory adherence to the plan. Owner reserves the right to require Contractor to make changes to the plan and operations, including removal of personnel, as necessary, to obtain specified quality of work results.

1.06 REFERENCES AND STANDARDS

- A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Comply with reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.
- C. Obtain copies of standards where required by product specification sections.
- D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.
- E. Should specified reference standards conflict with Contract Documents, comply with the higher quality or quantity, and provide documentation of the conflict to the Architect.
- F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Architect shall be altered from Contract Documents by mention or inference otherwise in any reference document.

1.07 TESTING AND INSPECTION AGENCIES AND SERVICES

- A. Owner will employ and pay for services of an independent testing agency to perform Special Inspections and other specified testing indicated in individual specification sections.
- B. Where indicated in individual specification sections, Contractor shall employ and pay for services of an independent testing agency to perform other specified testing.
- C. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
- D. Contractor Employed Agency: Testing agency shall comply with requirements of ASTM E 329, and shall be certified through OSHA's Nationally Recognized Testing Laboratory (NRTL) program or through the National Institute of Standards and Technology's (NIST's) National Voluntary Laboratory Accreditation Program (NVLAP).
 - 1. Testing Equipment: Calibrated at reasonable intervals either by NIST or using an NIST established Measurement Assurance Program, under a laboratory measurement quality assurance program.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.
- D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have work performed by persons qualified to produce required and specified quality.

- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.02 MOCK-UPS

- A. Before installing portions of the Work where mock-ups are required, construct mock-ups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship.
- B. Accepted mock-ups establish the standard of quality the Architect will use to judge the Work.
- C. Integrated Exterior Mockups: Construct integrated exterior mockups as indicated on drawings. Coordinate installation of exterior envelope materials and products as required in individual Specification Sections. Provide adequate supporting structure for mock-up materials as necessary.
- D. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.
- E. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- F. Obtain Architect's approval of mock-ups before starting work, fabrication, or construction.
 - 1. Architect will issue written comments within seven (7) working days of initial review and each subsequent follow up review of each mock-up.
 - 2. Make corrections as necessary until Architect's approval is issued.
- G. Architect will use accepted mock-ups as a comparison standard for the remaining Work.
- H. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

3.03 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

3.04 TESTING AND INSPECTION

- A. See individual specification sections for testing and inspection required.
 - B. Testing Agency Duties for Contractor-Employed Testing and Inspection Agencies:
 - 1. Test samples of mixes submitted by Contractor.
 - 2. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
 - 3. Perform specified sampling and testing of products in accordance with specified standards.
 - 4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 - 5. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
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6. Perform additional tests and inspections required by Architect.
 7. Attend preconstruction meetings and progress meetings.
 8. Submit reports of all tests/inspections specified.
- C. Limits on Testing/Inspection Agency Authority:
1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 2. Agency may not approve or accept any portion of the Work.
 3. Agency may not assume any duties of Contractor.
 4. Agency has no authority to stop the Work.
- D. Contractor Responsibilities:
1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
 2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
 3. Provide incidental labor and facilities:
 - a. To provide access to Work to be tested/inspected.
 - b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
 - c. To facilitate tests/inspections.
 - d. To provide storage and curing of test samples.
 4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
 5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
 6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
 7. Coordinate repairs where testing and inspection has damaged the Work.
- E. Re-testing and/or re-inspections required because of non-compliance with specified requirements shall be performed by the same agency. Do not proceed with construction activities that would conceal or cover work needing re-testing or re-inspection.
- F. Re-testing and/or re-inspections required because of non-compliance with specified requirements shall be paid for by Contractor.

3.05 MANUFACTURERS' FIELD SERVICES

- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, and field quality control requirements as applicable, and to initiate instructions when necessary.
- B. Provide a written report of observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions or Contract Documents. Obtain Owner's approval prior to proceeding with any modifications.

3.06 DEFECT ASSESSMENT

- A. Replace Work or portions of the Work not complying with specified requirements.

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- B. Contractor may request to restore defective Work or portions of the Work to comply with specified requirements in lieu of replacement. Obtain Owner's approval prior to proceeding with restoration.
- C. If, in the opinion of Owner, it is not practical to restore or remove and replace the work, Owner will direct an appropriate remedy or adjust payment.

END OF SECTION 014000

SECTION 014200
DEFINITIONS AND REFERENCE STANDARDS

PART 1 GENERAL

1.01 SUMMARY

- A. The definitions include in this section supplement, but do not replace, the definitions contained in the General Conditions. In the event of duplication, the General Conditions shall govern.
- B. Other definitions are included in individual specification sections.

1.02 DEFINITIONS

- A. Furnish: To supply, deliver, unload, and inspect for damage.
- B. Install: To unpack, assemble, erect, apply, place, finish, cure, protect, clean, start up, and make ready for use.
- C. Product: Material, machinery, components, equipment, fixtures, and systems forming the work result. Not materials or equipment used for preparation, fabrication, conveying, or erection and not incorporated into the work result. Products may be new, never before used, or re-used materials or equipment.
- D. Provide: To furnish and install.
- E. Supply: Same as Furnish.
- F. Installer: A Contractor or other entity engaged by Contractor, as an employee, subcontractor, or contractor of lower tier, to perform a particular construction operation, including installation, erection, application, and similar operations.
 - 1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that specified requirements apply exclusively to tradespeople of the corresponding generic name.
- G. Experienced: When used with the term "Installer," this term means having successfully completed previous work similar in size and scope to this Project; being familiar with the special requirements indicated; and having complied with the requirements of local authorities having jurisdiction.
- H. Replace: Provide an acceptable like product or material in place of a missing or unacceptable (rejected) product or material. To "replace" an unacceptable product or material includes its removal and disposal.
- I. Punch List: A written list of unfinished Work and defective Work resulting from inspection and testing to determine whether Substantial Completion has been accomplished. The unfinished Work and defective Work must be finished and corrected to obtain Substantial or Final Completion, in accordance with the General Conditions.
- J. Written or Printed: When used in conjunction with manufacturer's product data or installation requirements, either of these terms may be used to require compliance with manufacturer's current printed and published information.

1.03 REFERENCE STANDARDS

- A. For products or workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified, or are required by applicable codes or local authorities having jurisdiction.

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- B. Should specified reference standards conflict with Contract Documents, request clarification from the Architect before proceeding.
- C. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of the Architect shall be altered by Contract Documents by mention or inference otherwise in any reference document.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 014200

SECTION 014520 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Balancing Air Systems:
 - a. Constant-volume air systems.
 - b. Variable-air-volume systems.
- 2. Testing, Adjusting, and Balancing Equipment:
 - a. Motors.
 - b. Condensing units.
 - c. Heat-transfer coils.
- 3. Testing, adjusting, and balancing existing systems and equipment.

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. BAS: Building automation system.
- C. NEBB: National Environmental Balancing Bureau.
- D. TAB: Testing, adjusting, and balancing.
- E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

1.4 PREINSTALLATION MEETINGS

- A. TAB Conference: If requested by the Owner or Architect, conduct a TAB conference at Project site after approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Provide a minimum of 14 days' notice of scheduled meeting time and location.
 - 1. Minimum Agenda Items:
 - a. The Contract Documents examination report.

- b. The TAB plan.
- c. Needs for coordination and cooperation of trades and subcontractors.
- d. Proposed procedures for documentation and communication flow.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB agent and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 60 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 90 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- D. System Readiness Checklists: Within 90 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.
- E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.
- F. Certified TAB reports: Within 14 days of completion of balancing work, submit testing and balancing report.
- G. Sample report forms.

1.6 QUALITY ASSURANCE

- A. TAB Specialists Qualifications: Certified by AABC or NEBB. TAB provider shall be an independent company from the contractors performing the work.
 - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC or NEBB.
 - 2. TAB Technician: Employee of the TAB specialist and certified by AABC or NEBB as a TAB technician.
- B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- C. The following information shall be submitted as part of the Quality Assurance Submittal:
 - 1. Provide evidence of satisfactory completion of at least two projects of similar size and scope. **These projects must include an engineered smoke control system that utilizes the same strategy utilized on this project (pressurization method).** Submit the following for each project:
 - a. Completed testing and balancing reports for each project.

- b. If not included in the testing and balancing report, provide equipment startup checklists for each project.
 - c. Owner contact for each project.
 - d. Design engineer contact for each project.
 - e. Architect contact for each project.
 - 2. The Architect shall determine whether the agent is qualified and the decision shall be final. Re-submittals on behalf of the same company shall not be considered.
- D. TAB Conference: After approval of the TAB submittals, the TAB specialist shall arrange a meeting with the Owner's and the Architect's representatives to develop a mutual understanding of the details and review the TAB strategies and procedures plan. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installer, and other support personnel. Provide 14 days' notice of scheduled meeting time and location.
- 1. Minimum Agenda:
 - a. Submittal distribution requirements.
 - b. Contract documents examination report.
 - c. TAB strategies and procedures plan.
 - d. Work schedule and project site access requirements.
 - e. Coordination and cooperation of trades and subcontractors.
 - f. Coordination of documentation and communication flow.
 - g. Systems readiness checklists.
- E. TAB Reports: Use standard forms from AABC's "National Standards for TAB" or NEBB's "Procedural Standards for TAB of Environmental Systems."
- F. Instrumentation Type, Quantity, and Accuracy: As described in the "AABC National Standards for Total System Balance" or NEBB's "Procedural Standards for TAB of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

1.7 COORDINATION

- A. Coordinate the efforts of work performed under other sections for operation of systems and equipment to support and assist TAB activities.
- B. Notice: Provide 7 days' notice to the Contractor and Architect for each test. Include scheduled test dates and times.
- C. Perform TAB after any required leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.8 WARRANTY

- A. General Warranty: The national project performance guarantee indicated in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

- B. Special Guarantee: Provide a guarantee on NEBB or AABC forms stating that NEBB or AABC will assist in completing the requirements of the Contract Documents if the TAB Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:
 - 1. The certified Agent 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.

- B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

- C. Examine the approved submittals for HVAC systems and equipment.

- 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 ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

- F. Examine equipment performance data including fan and pump curves.
 - 1. 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.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in

AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design."
Compare results with the design data and installed conditions.

- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.
- L. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.
- P. 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 the following:
 - 1. Equipment and systems to be tested.
 - 2. Strategies and step-by-step procedures for balancing the systems.
 - 3. Instrumentation to be used.
 - 4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
 - 1. Airside:
 - a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
 - b. Duct systems are complete with terminals installed.
 - c. Volume, smoke, and fire dampers are open and functional.
 - d. Clean filters are installed.
 - e. Fans are operating, free of vibration, and rotating in correct direction.

- f. Variable-frequency controllers' startup is complete and safeties are verified.
- g. Automatic temperature-control systems are operational.
- h. Ceilings are installed.
- i. Windows and doors are installed.
- j. Suitable access to balancing devices and equipment is provided.

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 Total System Balance," ASHRAE 111, or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 - 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

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. Cross-check 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 outdoor-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. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."
- M. Verify total dryer vent static pressure with dryer in operation and with ductwork clean. Dryer vent static pressure will be used to determine BAS monitoring and alarm to indicate dryer vent needs cleaning. Coordinate with Division 23 Section "Sequence of Operations for HVAC Controls."

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 total airflow.
 - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
 - b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
 - c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
 - d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
 - 2. Measure fan static pressures as follows:
 - a. Measure static pressure directly at the fan outlet or through the flexible connection.
 - b. Measure static pressure directly at the fan inlet or through the flexible connection.
 - c. Measure static pressure across each component that makes up the air-handling system.
 - d. Report artificial loading of filters at the time static pressures are measured.
 - 3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 - 4. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 - 5. 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 occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
 - 1. Measure airflow of submain and branch ducts.
 - 2. Adjust submain and branch duct volume dampers for specified airflow.
 - 3. Re-measure each submain and branch duct after all have been adjusted.
- C. Adjust air inlets and outlets for each space to indicated airflows.
 - 1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
 - 2. Measure inlets and outlets airflow.
 - 3. Adjust each inlet and outlet for specified airflow.
 - 4. Re-measure each inlet and outlet after they have been adjusted.
- D. Verify final system conditions.
 - 1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
 - 2. Re-measure and confirm that total airflow is within design.
 - 3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
 - 4. Mark all final settings.
 - 5. Test system in economizer mode. Verify proper operation and adjust if necessary.
 - 6. Measure and record all operating data.
 - 7. Record final fan-performance data.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Adjust the variable-air-volume systems as follows:
 - 1. Verify that the system static pressure sensor is located two-thirds of the distance down the duct from the fan discharge.
 - 2. Verify that the system is under static pressure control.
 - 3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control set point so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
 - 4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:
 - a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.
 - b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
 - c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
 - d. Adjust controls so that terminal is calling for minimum airflow.

- e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
 - f. When in full cooling or full heating, ensure that there is no mixing of hot-deck and cold-deck airstreams unless so designed.
 - g. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.
5. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.
- a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
 - b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow so that connected total matches fan selection and simulates actual load in the building.
 - c. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
 - d. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
 - e. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
6. Measure fan static pressures as follows:
- a. Measure static pressure directly at the fan outlet or through the flexible connection.
 - b. Measure static pressure directly at the fan inlet or through the flexible connection.
 - c. Measure static pressure across each component that makes up the air-handling system.
 - d. Report any artificial loading of filters at the time static pressures are measured.
7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
- a. Balance the return-air ducts and inlets the same as described for constant-volume air systems.
 - b. Verify that terminal units are meeting design airflow under system maximum flow.
8. Re-measure the inlet static pressure at the most critical terminal unit and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls contractor.
9. Verify final system conditions as follows:
- a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
 - b. Re-measure and confirm that total airflow is within design.
 - c. Re-measure final fan operating data, rpms, volts, amps, and static profile.
 - d. Mark final settings.

- e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
- f. Verify tracking between supply and return fans.

3.7 PROCEDURES FOR MOTORS

- A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer's name, model number, and serial number.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Phase and hertz.
 - 5. Nameplate and measured voltage, each phase.
 - 6. Nameplate and measured amperage, each phase.
 - 7. Starter size and thermal-protection-element rating.
 - 8. Service factor and frame size.
- B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.8 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record fan and motor operating data.

3.9 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each water coil:
 - 1. Entering- and leaving-water temperature.
 - 2. Water flow rate.
 - 3. Water pressure drop for major (more than 20 gpm) equipment coils, excluding unitary equipment such as reheat coils, unit heaters, and fan-coil units.
 - 4. Dry-bulb temperature of entering and leaving air.
 - 5. Wet-bulb temperature of entering and leaving air for cooling coils.
 - 6. Airflow.
- B. Measure, adjust, and record the following data for each electric heating 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.
 - 5. Calculated kilowatt at full load.
 - 6. Fuse or circuit-breaker rating for overload protection.

- C. Measure, adjust, and record the following data for each steam coil:
 - 1. Dry-bulb temperature of entering and leaving air.
 - 2. Airflow.
 - 3. Inlet steam pressure.
- D. Measure, adjust, and record the following data for each refrigerant coil:
 - 1. Dry-bulb temperature of entering and leaving air.
 - 2. Wet-bulb temperature of entering and leaving air.
 - 3. Airflow.

3.10 PROCEDURES FOR SMOKE CONTROL SYSTEM TESTING

- A. Before testing smoke control systems, verify that construction is complete and verify the integrity of each smoke control zone boundary. Verify that windows and doors are closed and that applicable gaskets and sealants are installed. Report deficiencies and postpone testing until after the reported deficiencies are corrected.
- B. Measure and record wind speed and direction, outside-air temperature, and relative humidity on each test day.
- C. Measure, adjust, and record airflow of each smoke control system with all fans that are a part of the system operating as intended in design.
- D. Measure, adjust, and record the airflow of each fan. For ducted systems, measure the fan airflow by duct Pitot-tube traverse.
- E. After air balancing is complete, perform the following pressurization testing for each smoke control zone in the system:
 - 1. Verify the boundaries of each smoke control zone.
 - 2. With the HVAC systems in their normal mode of operation and smoke control not operating, measure and record the pressure difference across each smoke control zone. Make measurements after closing doors that separate the zones. Make one measurement across each door. Clearly indicate the high and low-pressure side of each door.
 - 3. With the system operating in the smoke control mode and with each zone in the smoke control system activated, perform the following:
 - a. Measure and record the pressure difference across each door that separates the smoke zone from adjacent zones. Make measurements with the doors that separate the smoke zone from the other zones closed. Clearly indicate the high and low-pressure side of the door. Adjust smoke control fans as necessary to achieve the following pressure differentials across the boundaries:
 - 1) Minimum pressure differential: +0.05 in. w.c.
 - 2) Maximum pressure differential: +0.08 in. w.c.
 - b. After testing a smoke zone's smoke control system, return the HVAC systems to their normal operating mode before activating another zone's smoke control system.
- F. Operational Tests:

1. Check proper activation of each zoned smoke control system in response to all means of activation, both automatic and manual.
2. Check automatic response to the fire alarm signals received from the building's fire alarm and detection system. Initiate a separate alarm for each means of activation to ensure that the proper operation of the correct zoned smoke control system occurs.
3. Check and record the proper operation of fans, dampers, and related equipment as outlined below for each separate zone of the smoke control system.
 - a. Fire zone in which smoke control system automatically activates.
 - b. Type of signal that activates a smoke control system, such as sprinkler water flow, space smoke detector, or duct mounted smoke detector.
 - c. Fan(s) "ON" as required to start the smoke control system.
 - d. Fan(s) or unit(s) "OFF" as required to start smoke control system.
 - e. Auxiliary functions to achieve the smoke control system configuration such as changes or overrides of normal operating sequences.
 - f. Test to verify that the system functions while operating under both normal and standby power.

- G. Demonstrate by the use of a smoke puffer that smoke moves in the correct direction.
- H. Provide smoke machine capable of filling typical smoke control zone for use during Department of Corrections system operation demonstration.
- I. Prepare a complete report of observations, measurements, and deficiencies.

3.11 TOLERANCES

- A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
1. Supply, Return, and Exhaust Fans and Equipment with Fans: 0 to plus 10 percent.
 2. Air Outlets: Plus or minus 10 percent.
 3. Return Inlets: Plus or minus 10 percent.
 4. Exhaust Inlets: 0 to plus 10 percent.
 5. Unless indicated otherwise: Plus or minus 10 percent.
- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.12 PROGRESS REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems balancing devices. Recommend changes and additions to systems balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare monthly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in

systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.13 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 - 2. Include a list of instruments used for procedures, along with proof of calibration.
 - 3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 - 1. Fan curves.
 - 2. Manufacturers' test data.
 - 3. Field test reports prepared by system and equipment installers.
 - 4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data:
 - 1. Title page.
 - 2. Name and address of the TAB specialist.
 - 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 supervisor 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's name, type, size, and fittings.
 - 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 - 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, 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.
- D. 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 outdoor, 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.
- E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
 - 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches, and bore.
 - i. Center-to-center dimensions of sheave and amount of adjustments in inches.
 - j. Number, make, and size of belts.
 - k. Number, type, and size of filters.
 - 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave and amount of adjustments in inches.
 - 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Filter static-pressure differential in inches wg.
 - f. Preheat-coil static-pressure differential in inches wg.
 - g. Cooling-coil static-pressure differential in inches wg.

- h. Heating-coil static-pressure differential in inches wg.
- i. Outdoor airflow in cfm.
- j. Return airflow in cfm.
- k. Outdoor-air damper position.
- l. Return-air damper position.
- m. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

- a. System identification.
- b. Location.
- c. Coil type.
- d. Number of rows.
- e. Fin spacing in fins per inch.
- f. Make and model number.
- g. Face area in square feet.
- h. Tube size in NPS.
- i. Tube and fin materials.
- j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

- a. Airflow rate in cfm.
- b. Average face velocity in fpm.
- c. Air pressure drop in inches wg.
- d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
- e. Return-air, wet- and dry-bulb temperatures in deg F.
- f. Entering-air, wet- and dry-bulb temperatures in deg F.
- g. Leaving-air, wet- and dry-bulb temperatures in deg F.
- h. Water flow rate in gpm.
- i. Water pressure differential in feet of head or psig.
- j. Entering-water temperature in deg F.
- k. Leaving-water temperature in deg F.
- l. Refrigerant expansion valve and refrigerant types.
- m. Refrigerant suction pressure in psig.
- n. Refrigerant suction temperature in deg F.
- o. Inlet steam pressure in psig.

G. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data:

- a. System identification.
- b. Location.
- c. Coil identification.
- d. Capacity in Btu/h.
- e. Number of stages.

- f. Connected volts, phase, and hertz.
 - g. Rated amperage.
 - h. Airflow rate in cfm.
 - i. Face area in square feet.
 - j. Minimum face velocity in fpm.
 - 2. Test Data (Indicated and Actual Values):
 - a. Heat output in Btu/h.
 - b. Airflow rate in cfm.
 - c. Air velocity in fpm.
 - d. Entering-air temperature in deg F.
 - e. Leaving-air temperature in deg F.
 - f. Voltage at each connection.
 - g. Amperage for each phase.
- H. Fan Test Reports: For supply, return, and exhaust fans, include the following:
 - 1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches, and bore.
 - h. Center-to-center dimensions of sheave and amount of adjustments in inches.
 - 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - g. Number, make, and size of belts.
 - 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Suction static pressure in inches wg.
- I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:
 - a. System and air-handling-unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F.
 - d. Duct static pressure in inches wg.
 - e. Duct size in inches.
 - f. Duct area in square feet.
 - g. Indicated airflow rate in cfm.
 - h. Indicated velocity in fpm.
 - i. Actual airflow rate in cfm.
 - j. Actual average velocity in fpm.
 - k. Barometric pressure in psig.

J. Air-Terminal-Device Reports:

1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Apparatus used for test.
 - d. Area served.
 - e. Make.
 - f. Number from system diagram.
 - g. Type and model number.
 - h. Size.
 - i. Effective area in square feet.
2. Test Data (Indicated and Actual Values):
 - a. Airflow rate in cfm.
 - b. Air velocity in fpm.
 - c. Preliminary airflow rate as needed in cfm.
 - d. Preliminary velocity as needed in fpm.
 - e. Final airflow rate in cfm.
 - f. Final velocity in fpm.
 - g. Space temperature in deg F.

K. System-Coil Reports: For reheat coils of terminal units, include the following:

1. Unit Data:
 - a. System and air-handling-unit identification.
 - b. Location and zone.
 - c. Room or riser served.
 - d. Coil make and size.
2. Test Data (Indicated and Actual Values):
 - a. Airflow rate in cfm.

- b. Entering-water temperature in deg F.
- c. Leaving-water temperature in deg F.
- d. Entering-air temperature in deg F.
- e. Leaving-air temperature in deg F.

L. Instrument Calibration Reports:

1. Report Data:

- a. Instrument type and make.
- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

3.14 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Owner.
- B. Owner shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- E. If TAB work fails, proceed as follows:
 - 1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
 - 2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
 - 3. If the second verification also fails, design professional may contact AABC Headquarters regarding the AABC National Performance Guaranty.
- F. Prepare test and inspection reports.

3.15 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

- B. When requested, provide up to 32 hours by the technician that provided services under this Section to support commissioning.

END OF SECTION 014520

SECTION 015000
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 DEWATERING

- A. Provide temporary means and methods for dewatering all temporary facilities and controls, in compliance with local authority having jurisdiction.
- B. Maintain temporary facilities in operable condition.

1.02 TEMPORARY UTILITIES

- A. Provide and pay for all electrical power, lighting, water, heating and cooling, and ventilation required for construction purposes.
- B. New permanent facilities may be used, with prior Owner authorization.
 - 1. Use of permanent facilities shall not impact specified warranties. Equipment shall be maintained during temporary usage.
- C. Temporary Lighting: Provide temporary lighting of type and producing lighting levels necessary for proper installation of the Work.
- D. Temporary Heating, Cooling, and Ventilation: Provide temporary measures and equipment as required for curing, drying, and humidity control. Comply with manufacturer's installation instructions for specific product requirements.
 - 1. Provide measures and equipment to meet warranty requirements of interior woodwork specified in Division 6 and/or Division 12 sections.
 - 2. Use of Permanent HVAC Facilities and Equipment: Use of HVAC equipment shall be subject to Owner approval.
 - a. Protect new and existing HVAC equipment from intrusion of dust, silica, dirt and debris during construction operations.
 - b. Cover all openings in new and existing inactive ductwork during construction operation with minimum 6 mil polyethylene sheet.
 - c. Where use of existing HVAC equipment is approved by Owner, provide temporary filters with a minimum MERV of 8. Change the filters every two weeks while construction is ongoing. Provide new filters at Substantial Completion; do not change out temporary filter until approved by Architect.
 - d. Do not perform testing and balancing of HVAC equipment until dust, silica, dirt and debris producing activities are complete.
- E. Temporary Water: For the duration of construction or until permanent water service is available at the site, the Contractor shall provide a temporary water source, as part of the Contract Price.
- F. Temporary Electric Service: Until electric utility provides permanent service at the site, the Contractor shall provide temporary electrical power, as part of the Contract Price.
- G. Temporary Sewer and Drainage: Comply with requirements of local authority having jurisdiction for connection of temporary sewer to public system.

1.03 TELECOMMUNICATIONS SERVICES

- A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.
- B. Telecommunications services shall include:

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1. Telephone Service: Contractor shall ensure that all of its forces, including on-site managers/supervisors of each Subcontractor, have mobile devices and adequate voice and data coverage for on-site operations.
2. Internet Connections: Contractor shall ensure that all of its forces have access to high speed internet connection with wireless capability; wireless network shall support Internet speed tests in excess of 5 Mbps symmetrical (up/down).
3. Video Conferencing and Video Site Visit/Walkthrough Infrastructure: Maintain personal computer/laptop with large format display screen and video conferencing software in the common-use field office.
 - a. Maintain equipment in common-use field office for site visits and walkthroughs, including a portable, high quality digital video camera, audio headset with microphone for walkthrough commentary/narration, and accessories including connection cables and battery packs.

1.04 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
 1. Provide temporary unisex toilet units and all required disposable supplies.
 2. Provide handwash stations and hand sanitizer at each toilet unit.
 3. Provide regular servicing of portable facilities by professional servicing company; including draining, cleaning, and disinfecting.
- B. New permanent facilities may not be used during construction operations.
- C. Maintain daily in clean and sanitary condition.

1.05 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
- B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building, and for emergency egress.
- C. Provide protection for plants designated to remain. Replace damaged plants.
- D. Protect vehicular traffic, stored materials, site, and structures from damage.

1.06 FENCING

- A. Barrier Mesh Fence: Provide minimum 6-foot height open-mesh polypropylene barrier fabric mounted on lumber or galvanized steel posts to isolate and define construction area and prevent accidental public access.
- B. Construction: Commercial grade chain link fence.
 1. Contractor may provide either fixed or portable fencing to suit conditions. For portable fencing, provide concrete or galvanized steel bases for supporting posts. Bases for portable fencing shall not obstruct sidewalks or other pathways used by pedestrians.
- C. Provide 6 foot high fence around construction site; equip with vehicular and pedestrian gates with locks.
- D. Unless otherwise indicated, provide barrier mesh fencing to enclose the approximate extent of the entire construction site. Chain link fencing shall be used to enclose Contractor's field office and laydown/storage areas, areas of the site actively in construction, and as deemed necessary by Contractor.

1.07 EXTERIOR ENCLOSURES

- A. Provide temporary weather tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

1.08 INTERIOR ENCLOSURES

- A. Provide temporary partitions to separate work areas from Owner-occupied areas, to prevent penetration of dust and moisture into Owner-occupied areas, and to prevent damage to existing materials and equipment.
- B. Construction: Framing and gypsum board sheet materials with closed joints and sealed edges at intersections with existing surfaces:

1.09 SECURITY

- A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.
 - 1. Contractor shall repair damage to existing facilities caused by Construction operations.
- B. Coordinate with Owner's security program.
- C. Environmental Protection: Comply with EPA, OSHA and other regulatory requirements to prevent contamination of site, air, and public sewer/runoff.
 - 1. Provide additional work restrictions and protective measures as indicated on Civil/Site Drawings and as specified in Section 011000 - Summary.

1.10 VEHICULAR ACCESS AND PARKING

- A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.
- B. Coordinate access and haul routes with governing authorities and Owner.
- C. Provide and maintain access to fire hydrants, free of obstructions.
- D. Provide means of removing mud from vehicle wheels before entering streets.
- E. Designated existing on-site roads may be used for construction traffic.
- F. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.
- G. Provide watering trucks, mulch, chemical stabilizers, or other control measures, complying with environmental protection requirements, to prevent airborne dust and silica from becoming a nuisance or health issue to Contractor personnel, neighboring properties, and the public.

1.11 WASTE REMOVAL

- A. See Section 017419 - Construction Waste Management and Disposal, for additional requirements.
- B. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
- C. Provide containers with lids. Remove trash from site periodically.
- D. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.

- E. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.12 PROJECT IDENTIFICATION

- A. Project signs are not part of the Contract.
 - 1. The Contractor may, at their option and expense, elect to provide Project identification signs. Proposed signs shall comply with layout and details indicated on Drawings, and shall be submitted for Owner approval. Unauthorized signs are not permitted.
- B. Provide project identification sign of design and construction indicated on drawings.
 - 1. Obtain and pay for any permits required for temporary signage by local authority having jurisdiction.
- C. Erect on site at location(s) established by Architect.
- D. Provide temporary directional signage as directed to facilitate site access for visitors and other construction personnel.
- E. No other signs are allowed without Owner permission except those required by law.

1.13 FIELD OFFICES

- A. Field Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture and drawing display table.
 - 1. Provide space for Project meetings, with table and chairs to accommodate 10 persons.
 - 2. Provide drinking water/water cooler and a private bathroom.
 - 3. Maintain the following materials in the field office, available to Architect and Owner's representative at all times:
 - a. A complete, up-to-date set of all Contract Documents, including FCs, RFIs, PCOs, and COs.
 - b. A complete, up-to-date set of all reviewed final shop drawings.
 - c. The most recent, up-to-date version of Contractor's Progress Schedule.
- B. Locate offices a minimum distance of 30 feet from other structures.

1.14 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.
- B. Remove temporary underground installations.
- C. Clean and repair damage caused by installation or use of temporary work.
- D. Restore existing facilities used during construction to original condition.
- E. Restore new permanent facilities used during construction to specified condition.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Rough Carpentry: 2x lumber, in length and depth required for floor to ceiling partitions. Partitions shall not be fastened to existing ceilings or flooring to remain. Provide additional bracing and concealed attachments to building structure.
- B. Gypsum Board: 1/2-inch gypsum wallboard; ASTM C 1396.

- C. Insulation: Mineral-wool fiber blankets; with maximum flame-spread and smoke-developed ratings of 25 and 50 when tested per ASTM E 84.
- D. Polyethylene Sheet: Minimum 10 mil reinforced sheeting; achieving a passing rating when tested per NFPA 701, and a maximum flame-spread rating of 15 when tested per ASTM E 84.
- E. Walk-Off Mats: Dust-, dirt- and silica-control walk-off mats at each entrance into the enclosed construction area and each entrance through temporary partitions.
- F. Hardware: Provide temporary hinges, latch, and lock at doors in temporary partitions. Where doors in temporary partitions are also indicated to serve as egress, provide ADA-compliant exit device and closer.

2.02 EQUIPMENT

- A. Fire Extinguishers: Provide portable UL rated extinguishers. Provide extinguisher types rated for potential classes of fire expected for construction work indicated.

PART 3 EXECUTION

3.01 ELEVATOR AND STAIR USAGE

- A. Use of new or existing elevator(s) is not permitted.
- B. Use of existing stairs is permitted. Cover existing finishes and maintain stairs without damage. Clean and restore stairs to Owner's approval at Substantial Completion.
- C. Use of new stairs is permitted. To prevent wear on finishes, do not install finishes on stairs until construction foot traffic can be minimized. Clean and prepare stair substrate thoroughly prior to installation of finishes. Cover finishes after installation, and clean and restore to Owner's approval at Substantial Completion.
 - 1. Provide temporary stairs until new stairs are available.

3.02 PEST CONTROL

- A. Provide pest-control services at regular intervals, performed in compliance with regulations of state regulations, and by a pest-control firm licensed in the state where the project is located. Any chemicals and pesticides used shall be approved by EPA and local authority having jurisdiction. Contractor's pest control plan shall ensure the facility is free of termites, roaches, rodents, and other pests at time of Substantial Completion.
 - 1. Coordinate with Owner's Integrated Pest Management (IPM) plan where applicable.
 - 2. Provide Owner with a minimum 72 hours pre-notification for pest-control treatments.

3.03 TEMPORARY FIRE PROTECTION

- A. Comply with International Fire Code, Chapter 33 "Fire Safety During Construction and Demolition" for preventing damage to structures under construction.
 - 1. Comply with NFPA 241 "Standard for Safeguarding Construction, Alteration, and Demolition Operations" for additional provisions and conditions that are not covered by Chapter 33 of the International Fire Code.
- B. Provide a fire-prevention program, review with all personnel on site, and post fire-prevention information in clearly visible area. Coordinate fire-prevention program with local fire department.
- C. Provide clearly labeled portable fire extinguishers.
- D. Provide fire watch in compliance with OSHA requirements during and after use of all potential ignition sources, including but not limited to, welders, grinders, cutting torches, heating and electrical equipment, and lighting.

- E. Do not allow smoking in areas under construction.

3.04 MOISTURE CONTROL

- A. Prevent the absorption of moisture and humidity by:
1. Sequencing the delivery of such materials so that they are not present in the building until wet work is completed and dry.
 2. Delivery and storage of such materials in fully sealed moisture-impermeable packaging.
 3. Provide sufficient ventilation for drying within reasonable time frame.
- B. Prior to building dry-in, store porous materials in a separate enclosed storage building. Keep all surfaces clear of standing water, and cover or otherwise protect all materials from water infiltration and damage. Do not enclose interior spaces until dry-in is complete and ventilation can remove excess moisture.
- C. After building dry-in, provide temporary mechanical ventilation for humidity and moisture control until the building HVAC system is operational. Do not store or install material in the building until ambient temperature and humidity is within manufacturer's acceptable range. Do not install wet materials, and ensure that substrates are fully dry prior to installing other materials over them.
- D. Provide continuous monitoring of installed materials. Remove gypsum board, wood products, and other mold-supporting products, if they become and remain wet for 48 hours. Remove and replace any materials showing visible signs of mold or mildew.

3.05 TEMPORARY FACILITY USAGE AND REMOVAL

- A. Maintenance and Usage: Keep temporary facilities clean and in well-maintained condition for the duration of the Project. Prevent misuse of or damage to facilities by construction personnel. Make repairs to temporary facilities or replace facilities as required to keep them in good operating condition and in compliance with applicable OSHA, local permitting, and other applicable regulations.
- B. Changeover: Coordinate changeover from temporary facilities to permanent facilities at Substantial Completion, unless an alternate arrangement for changeover has been agreed upon in writing by Owner.
1. Contractor shall be responsible for repair, restoration, and cleaning of permanent facilities that are used for construction purposes after changeover.
- C. Removal: Unless otherwise indicated, temporary facilities and controls are the property of the Contractor, and shall be removed upon Architect's approval when Contractor can demonstrate that they are no longer needed.
1. Comply with construction waste management and recycling requirements for temporary facilities and materials that are not able to be reused.
 2. After removal of temporary facilities and controls, complete all permanent construction that was not accessible due to the presence of temporary facilities.
 3. Remove materials that have become soiled or contaminated due to construction vehicle traffic, parking, temporary field offices, oil or other chemical spillage, and other temporary usage, and replace with clean material. Complete grading, landscaping, paving, and other site improvements, and repair or restore all damage to existing or previously completed site improvements.

END OF SECTION 015000

**SECTION 016000
PRODUCT REQUIREMENTS**

PART 1 GENERAL

1.01 DEFINITIONS

- A. Comparable Product: An unnamed product that is similar in quality and performance to named product(s).
- B. Basis-of-Design Product: A specific product selected by the Architect for use in the design process; based on certain performance characteristics, physical qualities or details, a specialized finish type, pattern, or color, or other indicated characteristics.

1.02 WARRANTIES

- A. Product warranties shall be provided in addition to and run concurrently to Contractor's general warranty/guarantee.
 - 1. Unless otherwise indicated, all warranty terms shall start on the date of Substantial Completion.
- B. Manufacturer's Warranty: A standard warranty issued by the product manufacturer, covering production and material defects.
- C. Special Warranties: Warranties in addition to standard manufacturer's warranty, covering fabrication, installation, or specific performance items such as weathertightness
- D. Warranty Form: Warranty shall be provided on either manufacturer's standard form or on specified form. When a sample warranty form is not included in the Project Manual, the warranty shall be on mutually agreed form.

PART 2 PRODUCTS

2.01 EXISTING PRODUCTS

- A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by Contract Documents.
- B. Unforeseen historic items encountered remain the property of the Owner; notify Owner promptly upon discovery; protect, remove, handle, and store as directed by Owner.
- C. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to the Owner, or otherwise indicated as to remain the property of the Owner, become the property of the Contractor; remove from site.

2.02 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by Contract Documents.
- B. Refer to Section 014000 - Quality Requirements, for additional source quality control requirements.
- C. Use of products having any of the following characteristics is not permitted:
 - 1. Made using or containing CFC's or HCFC's.
 - 2. Containing lead, cadmium, or asbestos.

2.03 PRODUCT OPTIONS

- A. Products Specified with a Single Named Product: Where required by Owner due to facility standards, provide the named product; no options or substitutions allowed.
- B. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
- C. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.
- D. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.
- E. Products Specified by Naming One or More Manufacturers with a Provision for Comparable Products: Unnamed comparable product may be submitted after award of Contract. Comply with requirements in "Comparable Products" article below.

2.04 BASIS-OF-DESIGN PRODUCTS

- A. Where a product is specified by naming a Basis-of-Design, comply with the following:
 - 1. Where a list of additional manufacturers is provided, provide the Basis-of-Design product or a comparable product by one of the listed manufacturers, in compliance with "Comparable Products" article below.
 - 2. Where a list of additional manufacturers is not provided, provide the Basis-of-Design product, or submit a substitution request in compliance with Section 012500 - Substitution Procedures.
 - 3. Basis-of-Design characteristics shall include requirements in the Specifications and on the Drawings.
 - 4. Where the Basis-of-Design lists a specific finish, manufacturers wishing to submit as a Comparable Product or as a substitution shall certify that they are able to provide an exact match to the specified finish, or that they will provide a custom finish to match.

2.05 COMPARABLE PRODUCTS

- A. Where a product is specified with a provision for comparable products, Contractors submitting a Comparable Product shall comply with the following:
 - 1. The submitted product shall not require changes to the Work, unless specifically approved by Architect. If changes are required, the Contractor shall resubmit the product as a substitution request, and the Contractor shall bear the cost of the changes, coordinate with other impacted contractors, and provide appropriate notations on record documents.
 - 2. Contractor shall provide, with the submittal, a detailed breakdown comparing the submitted product to at least one of the other listed products; list specified performance qualities, test results, dimensions, finish, and other critical properties.
 - 3. Contractor shall provide warranty data indicating that submitted Comparable Product complies with indicated warranty term(s).
- B. Comparable product submittals are subject to Architect's final approval. If a proposed product is found to be unacceptable, Contractor shall revert to one of the named products.

2.06 COLOR/FINISH OPTIONS

- A. Preselected Color/Finish: Where a specific manufacturer's premium or custom finish or color is indicated as the basis-of-design, other listed manufacturers shall certify that they can provide an exact match, or that they will provide pricing under the assumption that a custom finish or color will be required.

- B. Color/Finish Selection: Unless specifically indicated to either be a custom color or to be selected from manufacturer's standard range, color and finish selections shall be made from manufacturer's full range of options, including premiums, metallics, wood grains, etc.

2.07 MAINTENANCE MATERIALS

- A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.
- B. Deliver to location designated by Owner; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS

- A. Refer to Section 012500 - Substitution Procedures.

3.02 OWNER-FURNISHED PRODUCTS

- A. Owner-Furnished/Contractor-Installed Products: Refer to Section 011000 - Summary and to the Drawings for identification of Owner-furnished products for installation by Contractor. Products shall be identified as "Owner-furnished" or "OF/CI".
 - 1. Owner's Responsibilities for Owner-Furnished/Contractor-Installed Products:
 - a. Arrange for and deliver Owner reviewed shop drawings, product data, and samples, to Contractor.
 - b. Arrange and pay for product delivery to site.
 - c. On delivery, inspect products jointly with Contractor.
 - d. Submit claims for transportation damage and replace damaged, defective, or deficient items.
 - e. Arrange for manufacturers' warranties, inspections, and service.
 - 2. Contractor's Responsibilities for Owner-Furnished/Contractor-Installed Products:
 - a. Review Owner reviewed shop drawings, product data, and samples.
 - b. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
 - c. Handle, store, install and finish products.
 - d. Repair or replace items damaged after receipt.
- B. Owner-Furnished/Owner-Installed Products: Where products are indicated on Drawings as "NIC", "Owner-provided", or "OF/OI", the Owner shall furnish and install the indicated products. Coordinate with Owner for expected delivery dates.
 - 1. The Contractor shall allow for access by Owner's personnel or designated installer as necessary.
 - 2. The Contractor shall not be responsible for damage to in-place construction caused during delivery/installation of Owner-Provided products.

3.03 TRANSPORTATION AND HANDLING

- A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.
- B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.
- C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.

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- D. Transport and handle products in accordance with manufacturer's instructions.
- E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.
- H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.04 STORAGE AND PROTECTION

- A. Provide protection of stored materials and products against theft, casualty, or deterioration.
- B. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. Refer to Section 017419.
 - 1. Structural Loading Limitations: Handle and store products and materials so as not to exceed static and dynamic load-bearing capacities of project floor and roof areas.
- C. Store and protect products in accordance with manufacturers' instructions.
- D. Store with seals and labels intact and legible.
- E. Arrange storage of materials and products to allow for visual inspection for the purpose of determination of quantities, amounts, and unit counts.
- F. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.
- G. For exterior storage of fabricated products, place on sloped supports above ground.
- H. Provide off-site storage and protection when site does not permit on-site storage or protection.
- I. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- J. Comply with manufacturer's warranty conditions, if any.
- K. Do not store products directly on the ground.
- L. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- M. Prevent contact with material that may cause corrosion, discoloration, or staining.
- N. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- O. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION 016000

**SECTION 017000
EXECUTION AND CLOSEOUT REQUIREMENTS**

PART 1 GENERAL

1.01 SUBMITTALS

- A. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
 - 1. On request, submit documentation verifying accuracy of survey work.
- B. Project Record Documents: Accurately record actual locations of capped and active utilities.

1.02 QUALIFICATIONS

- A. For surveying work, employ a land surveyor registered in the State in which the Project is located and acceptable to Architect. Submit evidence of surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate. Employ only individual(s) trained and experienced in collecting and recording accurate data relevant to ongoing construction activities,
- B. For design of temporary shoring and bracing, employ a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

1.03 PROJECT CONDITIONS

- A. Use of explosives is not permitted.
- B. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- C. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.
- D. Perform dewatering activities, as required, for the duration of the project.
- E. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- F. Dust and Silica Control: Execute work by methods to minimize raising dust and silica from construction operations. Provide positive means to prevent air-borne dust and silica from dispersing into atmosphere and over adjacent property.
 - 1. Provide dust-proof enclosures to prevent entry of dust and silica that is generated outdoors.
 - 2. Provide dust-proof barriers between construction areas and areas continuing to be occupied by Owner.
- G. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
 - 1. Minimize amount of bare soil exposed at one time.
 - 2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
 - 3. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
 - 4. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.
- H. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.

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- I. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.
- J. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.
- K. Hazardous Materials: Do not use materials or products that contain hazardous substances, for permanently installed products and materials, installation materials, or for cleaning or other construction use.

1.04 COORDINATION

- A. See Section 011000 for occupancy-related requirements.
- B. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- C. Notify affected utility companies and comply with their requirements.
- D. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- E. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- F. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- G. Coordinate completion and clean-up of work of separate sections.
- H. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.
- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
- C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.

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- C. Examine and verify specific conditions described in individual specification sections.
- D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- E. Verify that utility services are available, of the correct characteristics, and in the correct locations.
- F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 LAYING OUT THE WORK

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of any discrepancies discovered.
- C. Contractor shall locate and protect survey control and reference points.
- D. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- E. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- F. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
- G. Utilize recognized engineering survey practices.
- H. Establish a minimum of two permanent bench marks on site, referenced to established control points. Record locations, with horizontal and vertical data, on project record documents.
- I. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
 - 1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
 - 2. Grid or axis for structures.
 - 3. Building foundation, column locations, ground floor elevations.
- J. Periodically verify layouts by same means.
- K. Maintain a complete and accurate log of control and survey work as it progresses.

3.04 GENERAL INSTALLATION REQUIREMENTS

- A. Fire Safety: Comply with provisions of current version of the International Fire Code, Chapter 33; "Fire Safety During Construction and Demolition" for preventing damage to structures under construction.
 - 1. In addition to compliance with regulatory requirements, conduct construction operations in compliance with NFPA 241, including applicable recommendations in Appendix A.

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- B. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- C. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- D. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- E. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- F. Make neat transitions between different surfaces, maintaining texture and appearance.

3.05 ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
 - 1. Verify that construction and utility arrangements are as indicated.
 - 2. Report discrepancies to Architect before disturbing existing installation.
 - 3. Beginning of alterations work constitutes acceptance of existing conditions.
- B. Keep areas in which alterations are being conducted separated from other areas that are still occupied.
 - 1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 015000.
- C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
 - 1. Where openings in exterior enclosure exist, provide construction to make exterior enclosure weatherproof.
 - 2. Insulate existing ducts or pipes that are exposed to outdoor ambient temperatures by alterations work.
- D. Remove existing work as indicated and as required to accomplish new work.
 - 1. Remove items indicated on drawings.
 - 2. Relocate items indicated on drawings.
 - 3. Remove miscellaneous hangers, exposed nails not serving as fasteners, and similar protrusions; remove adhesive residue and tape; fill anchorage holes; and otherwise patch and restore surface to be a uniform substrate.
 - 4. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; prepare substrate per manufacturer's requirements for successful application of new finish.
 - 5. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces.
- E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove, relocate, and extend existing systems to accommodate new construction.
 - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
 - 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - a. Disable existing systems only to make switchovers and connections; minimize duration of outages.

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- b. See Section 011000 for other limitations on outages and required notifications.
 - c. Provide temporary connections as required to maintain existing systems in service.
- 3. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.
- F. Protect existing work to remain.
 - 1. Prevent movement of structure; provide shoring and bracing if necessary.
 - 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 - a. Use cutting methods such as sawing, drilling, and grinding that do not create impact stresses on existing construction. Do not use striking methods such as chopping or hammering.
 - 3. Repair adjacent construction and finishes damaged during removal work.
- G. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
 - 1. When existing finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Architect.
 - 2. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.
- H. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.
- I. Refinish existing surfaces as indicated:
 - 1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
- J. Clean existing systems and equipment in all spaces impacted by alteration work.
- K. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.
- L. Do not begin new construction in alterations areas before demolition is complete.

3.06 CUTTING AND PATCHING

- A. Refer to Alterations article above for additional requirements related to cutting and patching of existing construction.
- B. Perform cutting and patching to:
 - 1. Complete the work.
 - 2. Fit products together to integrate with other work.
 - 3. Provide openings for penetration of mechanical, electrical, and other services.
 - 4. Match work that has been cut to adjacent work.
 - 5. Repair areas adjacent to cuts to required condition.
 - 6. Repair new work damaged by subsequent work.
 - 7. Remove samples of installed work for testing when requested.
 - 8. Remove and replace defective and non-complying work.

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- C. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to specified condition.
- D. Employ skilled and experienced installer to perform cutting and patching.
- E. Restore work with new products in accordance with requirements of Contract Documents.
- F. Fit work to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- G. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material to maintain existing fire ratings, to full thickness of the penetrated element.
- H. Patching:
 - 1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
 - 2. Match color, texture, and appearance.
 - 3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.07 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust and silica.
- D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.08 PROTECTION OF INSTALLED WORK

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- F. Protect work from spilled liquids. If work is exposed to spilled liquids, immediately remove protective coverings, dry out work, and replace protective coverings.
- G. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- H. Prohibit traffic from landscaped areas.
- I. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.09 SYSTEM STARTUP AND ADJUSTING

- A. Coordinate with requirements of Section 019113 - General Commissioning Requirements.
- B. Coordinate schedule for start-up of various equipment and systems.
- C. Notify Architect and Owner seven days prior to start-up of each item.
- D. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
- E. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- F. Verify that wiring and support components for equipment are complete and tested.
- G. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
- H. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- I. Adjust operating products and equipment to ensure smooth and unhindered operation.
- J. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.10 DEMONSTRATION AND INSTRUCTION

- A. See Section 017900 - Demonstration and Training.

3.11 FINAL CLEANING

- A. Execute final cleaning prior to Substantial Completion.
 - 1. Clean areas to be occupied by Owner prior to final completion before Owner occupancy.
- B. Use cleaning materials that are nonhazardous.
- C. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
- E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- F. Replace filters of operating equipment.
- G. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, and drainage systems.
- H. Clean site; sweep paved areas, rake clean landscaped surfaces.
- I. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.12 CLOSEOUT PROCEDURES

- A. Prior to Substantial Completion, complete the following:
 - 1. Provide startup, testing, and adjusting of all systems and equipment.

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- a. Demonstrate that air and water systems are balanced and that automatic temperature control system is in control of all equipment. This may require separate demonstrations if controls cannot be tested for applicable seasons of the year.
 - b. Submit written certification that testing/adjusting/balancing operations have been completed, and that systems are operation and under control in conformance with applicable specification section(s).
 - c. Submit written certification that all Building Commissioning has been completed.
 - d. Complete testing of the electronic security and detention systems and equipment, demonstrating security control.
2. Provide all inspections required by local authorities having jurisdiction to obtain Certificate of Occupancy, and provide written certification of completion of Special Inspections.
 3. Provide preventive maintenance services for all equipment used prior to Substantial Completion, and provide initial maintenance servicing for all products and equipment that will be subject to ongoing maintenance/service contracts.
 4. Provide final cleaning of all products, materials, and equipment, and provide touch up and restoration of exposed materials and finishes.
 5. Provide fresh batteries in all battery-powered products and equipment.
 6. Provide demonstration and training for Owner's personnel on all required systems and equipment.
 7. Coordinate a walkthrough with the Owner and the local fire department and other emergency services.
 8. To the maximum extent possible, remove temporary facilities and controls, construction equipment and tools, and similar items that are not part of the finished Work.
 9. Coordinate changeover with the Owner of permanent utilities, insurance requirements, and building's permanent keying and lock system.
- B. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.
- C. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.
- D. Conduct Substantial Completion inspection with representatives of Owner and Architect, and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.
1. At the Architect's sole discretion, based on the amount of outstanding work, the Architect may elect to decline to issue a Certificate of Substantial Completion and will provide a list of outstanding items that are required to obtain Substantial Completion. The Contractor shall request reinspection after the indicated items have been completed.
- E. Upon approval, the Architect shall prepare and distribute Certificate of Substantial Completion, and will include a list of outstanding items and Final Correction Punch List.
- F. The Owner will occupy the building after Substantial Completion, as specified in Section 011000.
- G. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.
- H. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.
- I. Prior to final completion, complete the following:
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1. Ensure that the Certificate of Substantial Completion is fully executed by all required parties.
2. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.
3. Provide final pest and rodent control treatments and inspections.
4. Remove any remaining construction equipment, tools, and materials; perform additional cleaning required due to construction activities following Substantial Completion, and leave the site prepared for Owner occupancy.
5. Submit final demonstration and training materials and videos, as built/record documents, operation and maintenance binders, and warranty binders.
6. Submit final application for payment.

3.13 MAINTENANCE

- A. Provide service and maintenance of components indicated in specification sections.
 1. Contractor's maintenance responsibility shall be through Substantial Completion, unless a longer term is required by individual specification section.
- B. Maintenance service shall not be assigned or transferred to any agent or third party without prior written consent of the Owner.

END OF SECTION 017000

SECTION 017419
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 GENERAL

1.01 WASTE MANAGEMENT REQUIREMENTS

- A. Owner requires that this project generate the least amount of trash and waste possible.
- B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.
- C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.
- D. Contractor Reporting Responsibilities: Submit periodic Waste Disposal Reports; report landfill disposal, incineration, recycling, salvage, and reuse regardless of to whom the cost or savings accrues; use the same units of measure on required reports.
- E. Methods of trash/waste disposal that are not acceptable are:
 - 1. Burning on the project site.
 - 2. Burying on the project site.
 - 3. Dumping or burying on other property, public or private.
 - 4. Other illegal dumping or burying.
- F. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.
 - 1. Fire Safety: Comply with International Fire Code, Chapter 33 "Fire Safety During Construction and Demolition" and with NFPA 241 for provisions relating to accumulation and removal of combustible debris and waste.

1.02 RELATED REQUIREMENTS

- A. Section 013000 - Administrative Requirements: Additional requirements for project meetings, reports, submittal procedures, and project documentation.
- B. Section 015000 - Temporary Facilities and Controls: Additional requirements related to trash/waste collection and removal facilities and services.
- C. Section 016000 - Product Requirements: Waste prevention requirements related to delivery, storage, and handling.
- D. Section 017000 - Execution and Closeout Requirements: Trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

1.03 DEFINITIONS

- A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.
- B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.
- C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.
- D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.

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- E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.
- F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.
- G. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.
- H. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- I. Return: To give back reusable items or unused products to vendors for credit.
- J. Reuse: To reuse a construction waste material in some manner on the project site.
- K. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.
- L. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.
- M. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.
- N. Toxic: Poisonous to humans either immediately or after a long period of exposure.
- O. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
- P. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.04 SUBMITTALS

- A. Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.
 - 1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.
 - 2. Submit Report on a form acceptable to Owner.
 - 3. Landfill Disposal: Include the following information:
 - a. Identification of material.
 - b. Amount, in tons or cubic yards, of trash/waste material from the project disposed of in landfills.
 - c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.
 - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
 - 4. Incinerator Disposal: Include the following information:
 - a. Identification of material.
 - b. Amount, in tons or cubic yards, of trash/waste material from the project delivered to incinerators.
 - c. State the identity of incinerators, total amount of fees paid to incinerator, and total disposal cost.
 - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
 - 5. Recycled and Salvaged Materials: Include the following information for each:

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- a. Identification of material, including those retrieved by installer for use on other projects.
 - b. Amount, in tons or cubic yards, date removed from the project site, and receiving party.
 - c. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.
 - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
 - e. Certification by receiving party that materials will not be disposed of in landfills or by incineration.
6. Material Reused on Project: Include the following information for each:
- a. Identification of material and how it was used in the project.
 - b. Amount, in tons or cubic yards.
 - c. Include weight tickets as evidence of quantity.
7. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 WASTE MANAGEMENT PROCEDURES

- A. See Section 013000 for additional requirements for project meetings, reports, submittal procedures, and project documentation.
- B. See Section 015000 for additional requirements related to trash/waste collection and removal facilities and services.
- C. See Section 016000 for waste prevention requirements related to delivery, storage, and handling.
- D. See Section 017000 for trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

3.02 WASTE MANAGEMENT PLAN IMPLEMENTATION

- A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.
- B. Communication: Distribute copies of the Waste Management Plan to Contractor's site superintendent, each subcontractor, Owner, and Architect.
- C. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.
- D. Meetings: Discuss trash/waste management goals and issues at project meetings.
 1. Prebid meeting.
 2. Preconstruction meeting.
 3. Regular job-site meetings.
- E. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
 1. Provide containers as required.

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2. Provide adequate space for pick-up and delivery and convenience to subcontractors.
 3. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.
- F. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.
- G. Recycling: Coordinate with Division 2 demolition contractor to properly identify and separate recyclables. Store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.
- H. Recycling of Existing Carpet: Remove carpet; cut sheet carpet to 4 foot widths, tightly roll, and pack in container. Palletize carpet tiles on 36 inch or smaller pallets; maximum 4 foot high. Tightly bind or shrink wrap packaged carpeting. Include carpet padding where applicable.
1. Coordinate with Division 2 demolition contractor.
 2. Coordinate with Division 9 carpet installer to include waste and scrap from new carpet work as applicable.
 3. Refer to Carpet America Recovery Effort (CARE) guidelines and ship or deliver carpet to a designated reclamation/recycling facility. <https://carpetrecovery.org/>
- I. Recycling of Existing Acoustical Ceiling Panels: Verify with ACP manufacturer that existing ceiling tiles can be recycled. Following verification, remove and stack ceiling tiles on pallets and wrap or band the pallet loads for pick up or delivery per recycler guidelines.
1. Coordinate with Division 2 demolition contractor.
 2. Coordinate with Division 9 ACP manufacturer's recycling program; contact recycler when there is a full trailer load or approx. 30,000 square feet of removed ceiling. Coordinate with recycler to arrange pick up from the project site and transport to recycling facility at no cost.
 3. If quantity to be recycled is less than 30,000 square feet, coordinate with ACP manufacturer for delivery to a consolidation point/facility at Contractor's cost.
- J. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.
- K. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

END OF SECTION 017419

**SECTION 017800
CLOSEOUT SUBMITTALS**

PART 1 GENERAL

1.01 SUBMITTALS

- A. Project Record Documents: Submit documents to Architect within 15 days after the date of Substantial Completion.
- B. Operation and Maintenance Data:
 - 1. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within 15 days after acceptance.
 - 2. Submit one PDF draft copy of completed documents within 15 days after the Closeout Conference. This copy will be reviewed and returned, with Architect comments. Revise content of all document sets as required prior to final submission.
 - 3. After revisions are complete, submit one bound hard copy and PDF electronic file of revised final documents in final form within 15 days after Substantial Completion.
- C. Warranties and Bonds:
 - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 15 days after acceptance.
 - 2. Make other submittals within 15 days after Date of Substantial Completion, prior to final Application for Payment.
 - 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 15 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Addenda.
 - 3. Change Orders and other modifications to the Contract.
 - 4. Miscellaneous record submittals.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
 - 1. Include revised Drawings reissued during Bidding and Construction.
- C. Store record documents separate from documents used for construction.
 - 1. Keep record documents in a location accessible to Architect for periodic review and reference.
 - 2. Maintain in legible condition. If record document set becomes damaged or excessively dirty, transfer comments to clean set prior to submittal to Architect.
- D. Record information concurrent with construction progress.
- E. Record Drawings: Legibly mark each item to record actual construction including:
 - 1. Measured depths of foundations in relation to finish first floor datum.

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2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 4. Field changes of dimension and detail.
 5. Details not on original Contract drawings.
- F. Miscellaneous Record Submittals: Where other specification sections require completion certifications, or closeout or record submittals, submit in a single binder organized by specification section.

3.02 ASSEMBLY OF RECORD DOCUMENTS

- A. Submittal for Architect's Review:
1. Submit PDF scanned copy of marked up prints.
 2. Architect shall review and provide comment on completeness
- B. Submittal for Distribution to Owner:
1. After Architect has approved for content and completeness, submit PDF scanned copy of final marked up prints, and submit hard copy originals.
 2. Submit full set of Drawings, regardless of whether any modification or markings are on each sheet.

3.03 OPERATION AND MAINTENANCE DATA

- A. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- B. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- C. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.04 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

- A. For Each Product, Applied Material, and Finish:
1. Product data, with catalog number, size, composition, and color and texture designations.
 2. Information for re-ordering custom manufactured products.
- B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
- C. Moisture protection and weather-exposed products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.
- D. Additional information as specified in individual product specification sections.
- E. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.05 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

- A. For Each Item of Equipment and Each System:

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1. Description of unit or system, and component parts.
 2. Identify function, normal operating characteristics, and limiting conditions.
 3. Include performance curves, with engineering data and tests.
 4. Complete nomenclature and model number of replaceable parts.
- B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
- C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
- D. Include color coded wiring diagrams as installed.
- E. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- F. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- G. Provide servicing and lubrication schedule, and list of lubricants required.
- H. Include manufacturer's printed operation and maintenance instructions.
- I. Include sequence of operation by controls manufacturer.
- J. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- K. Provide control diagrams by controls manufacturer as installed.
- L. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.
- M. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- N. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- O. Include test and balancing reports.
- P. Additional Requirements: As specified in individual product specification sections.

3.06 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

- A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.
- B. Where systems involve more than one specification section, provide separate tabbed divider for each system.
- C. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
- D. Cover: Identify each binder on front and spine with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.

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- F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.
- G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.
- H. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.
- I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- J. Arrangement of Contents: Organize each volume in parts as follows:
 - 1. Project Directory.
 - 2. Table of Contents, of all volumes, and of this volume.
 - 3. Operation and Maintenance Data: Arranged by system, then by product category.
 - a. Source data.
 - b. Product data.
 - c. Operation and maintenance data.
 - d. Field quality control data.
 - e. Photocopies of warranties and bonds.

3.07 WARRANTIES AND BONDS

- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 15 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.
- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Retain warranties and bonds until time specified for submittal.
- D. Manual: Bind in commercial quality 8-1/2 by 11 inch three D side ring binders with durable plastic covers.
- E. Cover: Identify each binder on front and spine with typed or printed title WARRANTIES AND BONDS, with title of Project; name, address and telephone number of Contractor and equipment supplier; and name of responsible company principal.
- F. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.
- G. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
- H. Provide photocopy of each warranty in operation and maintenance manuals; locate each warranty with applicable O&M data for product or equipment.

END OF SECTION 017800

**SECTION 017900
DEMONSTRATION AND TRAINING**

PART 1 GENERAL

1.01 SUMMARY

- A. Demonstration of products, systems, equipment, and other items where indicated in specific specification sections.
- B. Training of Owner personnel in operation and maintenance of products, systems, equipment, and as otherwise indicated in specific specification sections.

1.02 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Draft Training Plans: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
 - 1. Submit not less than four weeks prior to start of training.
 - 2. Revise and resubmit until acceptable.
 - 3. Provide an overall schedule showing all training sessions.
 - 4. Include at least the following for each training session:
 - a. Identification, date, time, and duration.
 - b. Description of products and/or systems to be covered.
 - c. Name of firm and person conducting training; include qualifications.
 - d. Intended audience, such as job description.
 - e. Objectives of training and suggested methods of ensuring adequate training.
 - f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
 - g. Media to be used, such as slides, hand-outs, etc.
 - h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.
- C. Training Manuals: Provide training manual for each attendee.
 - 1. Include applicable portion of O&M manuals.
 - 2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
 - 3. Provide one extra copy of each training manual to be included with operation and maintenance data.
- D. Training Reports:
 - 1. Identification of each training session, date, time, and duration.
 - 2. Sign-in sheet showing names and job titles of attendees.
 - 3. List of attendee questions and written answers given, including copies of and references to supporting documentation required for clarification; include answers to questions that could not be answered in original training session.
- E. Video Recordings: Submit digital video recording of each demonstration and training session for Owner's subsequent use.
 - 1. Format: DVD Disc.
 - 2. Label each disc and container with session identification and date.

3. Where available, provide manufacturer's pre-produced training videos in conjunction with live demonstration and training video.

1.03 QUALITY ASSURANCE

- A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
 1. Instructor shall be certified by the manufacturer or fabricator of system.
 2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 DEMONSTRATION - GENERAL

- A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.
- B. Demonstrations conducted during Functional Testing need not be repeated unless Owner personnel training is specified.
- C. Demonstration may be combined with Owner personnel training if applicable, and if acceptable to Owner.
- D. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
 1. Complete demonstrations within two weeks after the date of Substantial Completion.
 2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- E. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
 1. Complete demonstrations within two weeks after the date of Substantial Completion.

3.02 TRAINING - GENERAL

- A. Conduct training on-site, utilizing installed products and equipment, unless otherwise indicated.
- B. Provide training in minimum two hour segments.
- C. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.
- D. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
 1. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
 2. Typical uses of the O&M manuals.
- E. Product- and System-Specific Training:
 1. Review the applicable O&M manuals.
 2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.

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3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
 4. Discuss cleaning products and procedures, including recommended cleaning products and products that are detrimental to equipment operation or finishes.
 5. Provide hands-on training on all operational modes possible and preventive maintenance.
 6. Emphasize safe and proper operating requirements; discuss relevant health and safety issues, warning or error indications, and emergency procedures and shutdown.
 7. Discuss common troubleshooting problems and solutions. Include minor adjustments for resolving noise, vibration, and improving system efficiency.
 8. Discuss any peculiarities of equipment installation or operation.
 9. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage. Include discussion of continuing maintenance agreements and procedures.
 10. Review recommended tools and spare parts inventory suggestions of manufacturers.
 11. Review spare parts and tools required to be furnished by Contractor.
 12. Review spare parts suppliers and sources and procurement procedures.
- F. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

END OF SECTION 017900

**SECTION 018119
INDOOR AIR QUALITY REQUIREMENTS**

PART 1 GENERAL

1.01 SUMMARY

- A. Provide Indoor Air Quality (IAQ) Management Plan to remain in force during the construction period.
- B. Chapter 3 of the Sheet Metal and Air Conditioning National Contractors' Association (SMACNA) IAQ Guideline for Occupied Buildings Under Construction, 2nd Edition 2007, available from SMACNA (703-803-2980 or www.smacna.org).

1.02 SUBMITTAL

- A. Construction Indoor Air Quality Management Plan (CIAQM Plan).

PART 2 OBJECTIVES DURING CONSTRUCTION

2.01 PROTECTION

- A. Store all materials and equipment in a protected area (inside warehouse or storage trailer). Protect materials and equipment that are too large or heavy to store in a trailer from water and dirt/dust/debris.
 - 1. OPTION: When stored outside, provide two layers of minimum 8-mil poly on the ground and elevate equipment or material a minimum of 4 inches to allow water to run off. Secure top and sides with two layers of 8-mil poly to prevent water penetration and dust/dirt accumulation.
- B. Protect HVAC equipment from dust and odors. Do not store equipment in areas near painting, pressure washing, or excavation. Do not operate equipment during cutting or grinding of masonry or concrete.
 - 1. Refer to Division 23 for construction filter requirements for protection of mechanical duct systems during construction.
 - 2. Clean ductwork when installed. Cap ends with poly during construction to prevent contamination.
 - 3. Do not operate HVAC system until the exterior walls, roof, glass, doors and building filters are properly installed.
 - 4. If air handlers must be used during construction, provide filtration media with a Minimum Efficiency Reporting Value (MERV) of 8 at each air-handling unit. Provide specified prefilters and final filters for operation during construction or install temporary 4-inch MERV 8 filters at each return air grille for operation during construction.
 - 5. Replace all filtration media immediately prior to Substantial Completion.
 - a. Filtration media installed in air-handling units shall have a Minimum Efficiency Reporting Value (MERV) of 8.
 - 6. Do not perform Testing and Balancing until dust or odor generating activities are completed.

2.02 SOURCE CONTROL

- A. Minimize IAQ contaminants introduced by construction materials.
- B. Store waste construction materials a minimum of 30 feet away from the building.

- C. Do not smoke within 30 feet of the exterior building perimeter.

2.03 PATHWAY INTERRUPTION

- A. Provide barriers to contain construction areas to allow a portion of the building to be cleaned and then operate the HVAC system in that cleaned area. Acceptable barriers include dust curtains and temporary walls.
1. Protect areas of the building in which HVAC is operational by physical barriers from areas of the building not acceptable for operation of the HVAC system.
- B. Maintain areas within 30 feet of outdoor air intakes free of dust, dirt, debris, and volatile materials while the HVAC system is in operation.

2.04 HOUSEKEEPING

- A. As dust accumulates at the Site, it can become airborne when disturbed by nearby activity. Similarly, spills or excess applications of products containing solvents will increase odors at the Site. Leaving the Site wet or damp for more than a day could result in the growth of mold and bacteria. Therefore, Site cleanup and maintenance is important to maintaining good IAQ during construction.
- B. Perform the following to control contaminants at the Site:
1. Suppress dust with wetting agents or sweeping compounds.
 2. Provide an efficient dust collection method (e.g. a damp rag, wet mop, or vacuum equipped with a high efficiency particulate arrester (HEPA) filter or wet scrubber).
 3. Remove spills or excess applications of solvent-containing products immediately. Provide low-VOC emitting spot removers and cleaning agents near occupied areas.
 4. Remove accumulated water and keep work areas as dry as possible, including the use of dehumidification, if necessary.
 5. Once building is enclosed, vacuum with HEPA filtered vacuum cleaners to prevent settled dust from becoming airborne again.
 6. Protect porous materials from exposure to moisture. Replace items that remain damp for more than four hours.

END OF SECTION 018119

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. Commissioning (Cx) Plan will be prepared and issued for construction by the Commissioning Authority. The following is an outline of the Commissioning Plan:
 - 1. Introduction
 - a. Definition of Commissioning
 - b. Commissioning Goal
 - c. Purpose of the Commissioning Plan
 - 2. Roles and Responsibilities of the Commissioning Team
 - 3. The Commissioning Process during Construction
 - 4. Systems to be Commissioned
 - 5. Appendices
 - a. Preliminary Commissioning Activity Durations
 - b. Sample Pre-functional Checklists
 - c. Sample Functional Performance Testing Procedures

1.2 SUMMARY

- A. This section includes general requirements that apply to implementation of commissioning (Cx) without regard to specific systems, assemblies, or components. In the event of any conflicts or ambiguities between or among this specification section and other portions of the Contract Documents, including other specifications, then the stricter, greater or higher quality requirement shall control.
- B. Commissioning is a systematic process of ensuring that all building systems perform interactively according to the design intent and the owner's operational needs. This is ideally achieved by beginning in the design phase and documenting design intent and continuing through construction, acceptance and the Warranty Phase 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 and performance testing and training.
- C. Commissioning during the Construction Phase is intended to achieve the following specific objectives in accordance with the Contract Documents:
 - 1. Verify that the submittals for the equipment and systems to be commissioned meet the design intent and specifications.
 - 2. 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 the CM/GC and/or its installing subcontractors (hereinafter collectively referred to as the "Contractor").
3. Verify and document proper performance of equipment and systems.
 4. Verify that Operation and Maintenance (O&M) documentation is complete and delivered to the Owner.
 5. Verify that the Owner's operating personnel are adequately trained.
- D. The commissioning process is not intended to relieve the system designers or the Contractor of their obligations, including but not limited to their responsibility to provide a finished and fully functioning product. The Commissioning Authority (CxA) is hired directly by the Owner not the Contractor. All contractor responsibilities related to the commissioning process shall be included in the Contractor's base bid.
- E. Related Sections:
1. Division 01 Section "Submittal Procedures" for additional detail in submittals required for commissioning.
 2. Division 01 Section "Closeout Procedures" which defines substantial completion and functional completion, relative to commissioning.
 3. Division 01 Section "Testing, Adjusting, and Balancing for HVAC" which includes procedures for smoke control system testing.
 4. Division 01 Section "Operation and Maintenance Data" defines commissioning documentation requirements.
 5. Division 22 Section "Commissioning of Plumbing" for commissioning process activities for plumbing systems, assemblies, equipment, and components.
 6. Division 23 Section "Commissioning of Mechanical" for commissioning process activities for mechanical systems, assemblies, equipment, and components.
 7. Division 26 Section "Commissioning of Electrical Systems" for commissioning process activities for electrical systems, assemblies, equipment, and components.
- F. Abbreviations - The following are common abbreviations used in the Specifications and in the Commissioning Plan:
1. A/E Architect and Engineer of Record
 2. AHJ Authority Having Jurisdiction
 3. BECx Building Enclosure Commissioning
 4. BOD Basis of Design
 5. CC Controls Contractor
 6. CxA Commissioning Authority or Agent
 7. Cx Commissioning
 8. CxC Commissioning Coordinator
 9. Cx Plan Commissioning Plan Document

10.	EC	Electrical Contractor
11.	GC	General Contractor
12.	FPT	Functional Performance Testing
13.	CM	Construction Manager
14.	MC	Mechanical Contractor
15.	OPM	Owner's Project Manager
16.	OPR	Owner's Project Requirements
17.	PFC	Pre-Functional Checklists
18.	TAB	Test, Adjust and Balance Contractor

1.3 DEFINITIONS

- A. Acceptance Phase: This is the phase of the project when the facility and its systems and equipment are inspected, tested, verified, and documented; and when most of the Functional Performance Testing, O&M documentation review and formal training occurs. This will generally occur after the Construction Phase is complete (startup and checks have been accomplished).
- B. Action Item (AI): Any issue that requires a response, completion, corrective or additional work, or any other action. Examples include a Request for Information (RFI), a work directive, a clarification request, a to-do item, an identified deficiency, or any other like item. Action Items must be categorized as appropriate.
- C. Approval/Acceptance: Acceptance that a piece of equipment or system has been properly installed and is functioning in the tested modes according to the Contract Documents.
- D. Architect/Engineer (A/E): The prime consultant (Architect and/or Engineer) and sub-consultants who comprise the design team, generally the HVAC mechanical designer/engineer and the electrical designer/engineer.
- E. Basis of Design (BOD) Document: The basis of design, also known as the design narrative. A document that records the concepts, calculations, decisions, and product selections used to meet the OPR and satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.
- F. Building Automation System (BAS): The computer-based control or automation system. May also be referred to as the FMS.
- G. Commissioning Authority/Agent (CxA): The entity identified by the Owner who leads, plans, schedules, and coordinates the Cx team to implement the Cx process.
- H. Commissioning Issues Log: A log created and updated by the CxA to track and maintain the updates of issues found during the Commissioning Process.
- I. Commissioning Plan (Cx Plan): A document developed by the CxA that outlines the organization, schedule, allocation of resources, documentation requirements, etc. of the commissioning process.

- J. Commissioning Process: A quality-focused process for enhancing the delivery of a project. This process focuses upon verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the OPR.
- K. Contractor: As used herein, 'Contractor' is a general reference to the installing Party and can therefore refer to the Prime/Construction Manager (CM) or General Contractor (GC), subcontractors (Controls Contractor (CC), Electrical Contractor (EC), Mechanical Contractor (MC), Plumbing Contractor (PC), Fire Protection Contractor (FP), Fire Alarm Contractor (FA)), or vendors as inferred by its usage.
- L. Construction Phase: Phase of the project during which the facility is constructed and/or systems and equipment are installed and started. Contractor and subcontractors complete the installation, complete startup documentation, submit O&M information, establish trends, and perform any other applicable requirements to get systems started. Contractor and Vendors may also conduct equipment specific training. The Construction Phase will generally end upon completed startup and TAB of systems and equipment.
- M. Contract Documents: The documents governing the responsibilities and relationships between Parties involved in the design and construction of this project including (but not necessarily limited to):
 - 1. Agreements/Contracts
 - 2. Construction Plans and Drawings
 - 3. Specifications
 - 4. Addenda and Bulletins
 - 5. Change Orders
- N. Data Logging: The monitoring and recording of flows, currents, status, pressures, etc. of equipment using stand-alone data loggers separate from the control systems
- O. Deferred Functional Tests: Functional tests 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.
- P. 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).
- Q. Facility Management System (FMS): Alternate reference to the computer-based control or automation system. May also be referred to as automatic temperature control (ATC) system, direct digital control (DDC) system, building automation system (BAS), building management system (BMS), building management and control system (BMCS), digital control system (DCS), Energy Management System (EMS), Energy Management and Control System (EMCS) or System Control And Data Acquisition (SCADA) System.
- R. Factory Authorized Representative: An individual fully trained on the equipment and certified by the manufacturer to perform the respective task.

- S. Factory Testing: Testing of equipment on-site or at the factory by factory personnel with an Owner's representative present.
- T. Functional Performance Test (FPT): 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. 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. FPT's are performed after pre-functional checklists and startup are completed.
- U. Indirect Indicators: Indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100% closed.
- V. 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").
- W. Monitoring: The recording of parameters (flow, current, status, pressure, etc.) of equipment operation using data loggers or the trending capabilities of control systems.
- X. Non-Compliance: See Deficiency.
- Y. Non-Conformance: See Deficiency.
- Z. Non-Productive Time: Time spent by the CxA on-site for the purpose of witnessing procedures and/or testing (static pressure testing, hydronic flushing/purging procedures, functional performance tests, etc.) scheduled by the contractor, where progress is found to be incomplete thus preventing the procedure and/or testing from occurring, and requiring the CxA to return to the project site at a later date to observe the same procedure. Non-productive time does not include time spent during FPT waiting for the contractor to correct minor issues such as sensor calibration, set-point adjustments, or other issues that arise during FPT that allow the procedure and/or testing to continue with minor delays, nor does it include retesting a portion of the completed FPT to verify an issue was resolved.
- AA. 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 50°F to 75°F to verify economizer operation). See also "Simulated Signal."
- BB. Owner/Owner's Project Manager (OPM): Responsible individual representing the Owner in the overall construction project through whom all decisions and direction are made.
- CC. Owner's Project Requirements (OPR), also known as the Request for Proposal (RFP): A written document that details the functional requirements of a project and the expectations of how it will

be used and operated. This includes project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

- DD. Pre-functional Checklist (PFC): A form, provided by the CxA or installing contractor, used by the installing contractor to verify that appropriate components are on-site, correctly installed, started-up and ready for functional performance testing. Pre-functional checklists are primarily static inspections and procedures to prepare the equipment or system for initial operation.
 - EE. Sampling: Functional performance testing of a portion of the total number of identical or near identical pieces of equipment.
 - FF. Seasonal Performance Tests: FPTs that are deferred until the system(s) will experience conditions closer to their design conditions.
 - GG. Simulated Condition: Condition that is created for the purpose of testing the response of a system.
 - HH. 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.
 - II. Startup: Refers to the process whereby the Contractor verifies the proper installation of a device or piece of equipment, executes the manufacturer's starting procedures, completes the Startup Checklist and PFC, energizes the device, verifies that it is in proper working order and ready for dynamic testing, and completes the Startup Tests.
 - JJ. TAB: Can refer to the test, adjust, and balance process or the Testing, Adjusting, and Balancing Contractor.
 - KK. Test Procedures: The step-by-step process which must be executed to fulfill the test requirements. The test procedures are developed by the CxA.
 - LL. 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
 - MM. Trending: Monitoring using the building control system.
 - NN. 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. Scheduling: The CxA will work with the CM/GC according to established protocols to schedule the commissioning activities. The CxA will provide sufficient notice to the CM/GC for scheduling commissioning activities. The CM/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.
 - B. The CxA will provide the initial schedule of primary commissioning events at the commissioning kick-off meeting. The Commissioning Plan - Construction Phase provides a format for this

schedule. As construction progresses more detailed schedules are developed by the CxA to be incorporated into the Contractor's construction schedule.

1.5 SYSTEMS TO BE COMMISSIONED

- A. Commissioning of equipment or systems specified for this project is part of the construction process. Documentation and testing of these systems, as well as training of the Owner's Operation and Maintenance personnel, is required in cooperation with the Owner and the Commissioning Authority.
- B. The Contractor is responsible for providing full commissioning of 100% of the systems and equipment included below as part of the Construction Phase of this project regardless of the sampling rate of the CxA.
- C. Systems to be commissioned as part of this project include but are not limited to the list below. Quantities shown in parenthesis indicate an approximate sampling amount of each system/equipment type for which the Contractor is to include commissioning time in their bid to allow for the verification of functional performance testing results as directed by the CxA. The CxA shall refine this list and the sampling quantity in the final Cx Plan. If during verifications, it is determined that significant deficiencies in functional performance exist even after the contractor has indicated that systems meet the performance requirements, the CxA may expand the sampling quantity to a greater amount to verify the deficiencies of each piece of equipment. In the event this becomes necessary, the Contractor will be charged and will pay for the additional costs incurred by the CxA, A/E, and Owner to perform additional verification/witnessing
 - 1. Division 22 Plumbing (% sampling rate)
 - a. Gas-fired hot water heater (100%)
 - b. Recirculation pumps (100%)
 - 2. Division 23 Mechanical and Controls (% sampling rate)
 - a. Smoke control exhaust fans (100%)
 - b. Firefighter smoke control panel (100% - coordination with Div 28)
 - c. Air handling unit smoke control sequencing (100%)
 - 3. Division 26 Electrical
 - a. Emergency Generator (100%)
 - b. Automatic transfer switch (100%)
 - c. Room lighting controls including occupancy/daylight sensors and wall switches (20%)
 - d. Fire alarm system limited to interface with mechanical system (100%)
 - 4. Division 28 Electronic Safety and Security
 - a. Firefighter smoke control panel (100% - coordination with Div 23)
- D. Smoke control systems shall be commissioned, tested, and inspected in accordance with the applicable sections of the North Carolina Building Code 2018, NFPA 92, and the Authority Having Jurisdiction (AHJ) requirements.
 - 1. Commissioning shall include all acceptance tests and special inspections required by 909.3, and 909.18, including but not limited to:
 - a. Functional performance testing of fans, dampers, and controls in all smoke control modes.

- b. Verification of pressure differentials, airflows, and door opening forces as defined in the Contract Documents.
 - c. Verification of fire alarm interface and control logic.
- 2. Contractor(s) shall provide full cooperation, labor, and access for commissioning, testing, and inspection activities.
- 3. All trades with scope affecting the smoke control system shall participate in the commissioning process and acceptance testing.

1.6 COMMISSIONING TEAM

A. Members Appointed by Contractor(s):

- 1. 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 CM/GC and representatives of the Contractor, including Project superintendent and sub-contractors, 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. Engineering design professionals.

1.7 RESPONSIBILITIES

A. Refer to the attached Cx Plan for the roles and responsibilities for each party in the commissioning process. The responsibilities of the mechanical contractor, TAB, and controls contractor are in Division 23. The plumbing contractor's are in Division 22. The electrical contractor's are in Division 26. Electronic Safety and Security contractor's are in Division 28. For testing systems requiring the support of equipment suppliers and vendors, responsibilities are as follows:

B. Equipment Supplier/Vendor Responsibilities

- 1. Construction Phase: The following delineates the commissioning-related responsibilities of the Equipment Supplier during the Construction Phase.
 - a. Provide shop drawings and product data in hard copy and electronic format.
 - b. Provide manufacturer's application, installation and startup instructions within 30 days of shop drawing/product data approval.
 - c. Where factory-authorized startup is specified, coordinate and participate in the specified commissioning process and document startup on the appropriate forms.
 - d. Review and approve Functional Test Procedures affecting supplied equipment.
 - e. Where training is to be provided by factory-authorized personnel, provide required training plan information including course content for approval by A/E and review and comment by CxA prior to conducting the training.

- f. Conduct and document Equipment and Systems Training events as required by this section and by applicable sections of the specifications pertaining to each piece of equipment or system.
 - g. Provide spare parts and materials as required by specifications.
 - h. Provide special tools as required by the specifications.
 - i. Provide content as required and develop project-specific O&M content as required by the Commissioning requirements.
 - j. Provide all specified warranties.
- 2. Acceptance Phase: The following delineates the commissioning-related responsibilities of the Equipment Supplier during the Acceptance Phase.
 - a. Participate in any Functional Performance Testing and Demonstrations required.
 - b. Consult on issues identified relative to the supplied equipment.
- 3. Warranty Phase: The following delineates the commissioning-related responsibilities of the Equipment Supplier during the Warranty Phase.
 - a. Provide any warranty service required to the supplied equipment as applicable with the agreement with the Contractor.
 - b. Provide technical support to the Owner's facilities personnel.

1.8 WEB-BASED COMMISSIONING PORTAL

- A. All general and major contractors participating in the Cx process shall use the web-based Cx Portal, CxAlloy ("Portal" or "CxAlloy") to document the Cx procedures. The Portal is a Web-based Internet hub used to electronically collaborate and coordinate activities and deliverables throughout the Cx process. The Portal is hosted by the CxA and shall be accessible to all Parties participating in the Cx program. The Portal provides a common location to store Pre-Functional Checklists (PFCs), Startup Documentation, Functional Performance Tests (FPTs) and results, Issues Log tracking, project documents and deliverables. It also serves as a collaborative e-mail hub to facilitate, automate, and track communications between Parties relating to the Cx process.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. All standard testing equipment required to perform startup and initial pre-functional checkout and required functional performance testing shall be provided by the installing contractor for the equipment being tested. All testing equipment used in the commissioning process shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified.
- 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 data logging equipment that may be used by the CxA.
- C. Data logging 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. If not otherwise noted, the following minimum requirements apply:
 - 1. All test instruments shall have had a certification within the last 12 months.
 - 2. Pressure testing equipment and digital thermometers shall have a certified calibration within the past year to an accuracy double that of the instrument being tested/calibrated.
- E. Repair and recalibrate test equipment and instrumentation if dismantled, dropped, or damaged since last calibrated.

PART 3 - EXECUTION

3.1 MEETINGS (Contractors shall include time in their base bid for CxA meetings)

- A. Cx Kick-off Meeting: The CxA will schedule, plan and conduct a commissioning kick-off meeting with the project commissioning team. Meeting minutes will be distributed to all parties by the CxA. Information gathered from this meeting will allow the CxA to revise their preliminary Commissioning Plan to its "final" version, which will also be distributed to all parties. The following will be discussed at this meeting:
 - 1. The Commissioning Documents.
 - 2. Requirements of Commissioning.
 - 3. Responsibilities of the construction parties.
 - 4. Management protocols.
 - 5. Submittals.
 - 6. Schedule.
- B. Miscellaneous Meetings: Up to four (4) additional meetings will be planned and conducted by the CxA as construction progresses. These meetings will cover coordination, deficiency resolution and planning issues with the CM/GC and affected subcontractors. The CxA will plan these meetings and will minimize unnecessary time being spent by Subcontractors. These meetings will be held as necessary throughout the construction period.

3.2 FIELD OBSERVATIONS

- A. The CxA will provide commissioning field observation reports with commissioning issues logs of non-conformance issues with increasing frequency as construction and commissioning progresses. All field observation reports and issues logs will be communicated through the web-based commissioning portal (CxAlloy).

- B. The CxA will regularly communicate with all members of the commissioning team, keeping them apprised of commissioning progress and scheduling changes through emails, progress reports, etc.

3.3 REPORTING

- A. The CxA will provide commissioning site observation reports with commissioning issues logs of non-conformance items, to the OPM and copy the CM/GC, with increasing frequency as construction and commissioning progresses.
- 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 comments and non-conformance and deficiency reports are made regularly with the review and testing as described in later sections.

3.4 SUBMITTALS AND DOCUMENTATION

- A. Contractor shall provide to the Commissioning Authority the following per the procedures specified herein and in other Sections of the specification:
 - 1. Shop Drawings and Product Data: Information related to systems or equipment to be commissioned. Commissioning Authority shall review and incorporate comments via the Design Engineer. Documentation shall include spare parts lists.
 - 2. Draft Startup Procedures: Contractor shall develop Startup Procedures for all applicable equipment and systems along with the manufacturer's application, installation and startup procedures. CxA may initially provide to the Contractor generic Startup Checklists, the content of which must be reviewed by the Contractor and supplemented with manufacturer-specific requirements and the Contractor's own internal quality assurance procedures and checks. CxA will review drafts and provide comments.
 - 3. Factory Test Reports: Contractor shall provide any factory testing documentation or certified test reports required by the specifications. These shall be provided prior to Acceptance Phase.
 - 4. Schedule Updates: Issue periodic updates to the construction schedule. Provide to the CxA at least once per month before building is closed in and every two weeks thereafter. Contractor shall use schedule to notify commissioning team of scheduled startup and training activities.
 - 5. Action Item/Commissioning Issue Response: Responses to Action Items/Issues Log Items to which commissioning team members assign the Contractor responsibility. Issues and responses shall be tracked through MBPs web-based commissioning portal, CxAlloy.
 - 6. Field Testing Agency Reports. Provide all documentation of work of independent testing agencies required by the specification. These shall be provided prior to Acceptance Phase.
 - 7. Completed Startup Procedures and Pre-Functional Checklists (PFC): Completed Startup Procedure and PFC documentation for all applicable equipment and systems. CxA will review prior to functional performance testing.
 - 8. Completed and approved TAB report(s) for all equipment and systems. CxA will review and schedule a TAB verification visit prior to any functional performance testing.

9. Nameplate Data Documentation: Provide prior to the start of the Acceptance Phase.
 10. Equipment Warranty's: Provide prior to the start of the Acceptance Phase.
 11. Training Plan: Provide prior to the start of the Acceptance Phase.
 12. Record Training Documentation: Provide at least 7 days prior to the start of the applicable training.
 13. Provide O&M Documentation content per the requirements of this section, and Division 1 requirements. Submit at least one month prior to the beginning of the Acceptance Phase.
- B. The CxA will provide appropriate contractors with a specific request for additional 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. The request will include, at a minimum, the manufacturer and model number, the manufacturer's printed installation and detailed startup procedures, full sequences of operation, O&M data, performance data, any performance test procedures, control drawings, spare parts lists, preventive maintenance schedules 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 CxA. All documentation requested by the CxA will be included by the sub-contractors in their O&M manual documentation.
- C. The CxA 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 CxA will notify the CM/GC or A/E as requested, of items missing or areas that are not in conformance with Contract Documents and which require resolution.
- D. 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.
- E. 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 comment on them.
- F. Record Drawings: Contractor shall maintain at the site an updated set of record documents reflecting actual installed conditions and all approved changes and modifications to the Contract Documents. Contractor shall provide access to the CxA to review the Record Drawings. Provide Record Drawings in accordance with Division 01.
- 3.5 CALIBRATIONS
- A. 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 field calibrated. Verify that all locations are appropriate and away from causes of erratic operation (i.e. unstable flow conditions, other heat sources, vibration, etc.).

2. Verify that the sensor reading (via the permanent thermostat, gage or BAS) is within the tolerances defined in the controls specification section [230900-29] of the instrument-measured value over the full range of expected control. If not, install offset in the BAS, calibrate or replace sensor. If tolerances are not defined in the controls specification, the tolerances as indicated in the table below shall be used.
3. Tolerances, Standard Applications

<u>Sensor</u>	<u>Required Tolerance (+/-)</u>		<u>Sensor</u>	<u>Required Tolerance (+/-)</u>
Cooling coil, chilled and condenser water temps	1.0°F		Flow rates, water Relative humidity	4% of de- sign 3% of de- sign
AHU wet bulb or dew point	1.0°F		Combustion flue temps	4.0°F
Hot water coil and boiler water temp	1.0°F		Oxygen or CO ₂ monitor	0.1 % pts
Outside air, space air, duct air temps	1.0°F		CO monitor	0.01 % pts
Watt hour, voltage and amperage	1%		Barometric pressure	0.1 in. of Hg
Pressures, air, water and gas	2%		Flow rates, air	+/-10%

B. Valve and Damper Stroke Check

1. BAS Readout: For all valve and damper actuator positions checked, including fully open or closed and intermediate positions, verify the actual position against the BAS readout. Verify fail-safe operation. If actual valve or damper position doesn't reasonably correspond after adjustments, replace actuator.

3.6 PRE-FUNCTIONAL CHECKLISTS, STARTUP AND INITIAL CHECKOUT

- A. The following procedures apply to all equipment to be commissioned, according to Part 1.5 - "Systems to be Commissioned" from above, and any additional systems or equipment identified by the CxA. Some systems that are not comprised so much of actual dynamic machinery, e.g., electrical systems, may have very simplified PFCs and startup.
- B. Pre-functional 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 pre-functional checkout by the installing contractor(s). The CxA will perform random sampling strategies to verify proper completion of the PFCs. The pre-functional testing for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.
- C. Four weeks prior to startup, the CM/GC shall schedule installing contractors and vendors for equipment startup and checkout and coordinate with the CxA. The performance of the pre-

functional checklists, startup and checkout are directed and executed by the installing contractors or vendors.

- D. The CxA may observe the procedures for each piece of primary equipment, unless there are multiple units (in which case a sampling strategy may be used).
- E. For lower-level components of equipment (e.g., fan-coil units, sensors, controllers), the CxA may observe a sampling of the pre-functional and startup procedures.
- F. The installing contractors and vendors shall execute startup and provide the CxA with the completed startup and pre-functional tests and checklists.
- G. Only individuals that have witnessed that a line item task on the pre-functional checklist was actually performed shall initial or check that item off.
- H. Clearly list any outstanding items of the initial startup and pre-functional procedures that were not completed successfully. The procedures form and any outstanding deficiencies are provided to the CxA within a week of test completion.
- I. The Contractor shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner. The CM/GC shall notify the CxA as soon as outstanding items have been corrected and resubmit an updated startup report and a Statement of Correction on the original non-compliance report.
- J. Deficient items identified during pre-functional testing and initial startup not corrected, which later cause deficiencies or delays during functional performance testing, will result in back charges to the CM/GC for the CxA's time to perform any retesting. The installing contractor shall be responsible for performing retests of deficient pre-functional or functional tests at its own cost.

3.7 FUNCTIONAL PERFORMANCE TESTING

- A. This sub-section applies to all commissioning functional testing for all divisions.
- B. 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, control sequences and parameters. Using the testing parameters and requirements in Divisions 01, 22, 23, 26, and 28, the CxA shall develop specific test procedures and forms to verify and document proper operation of each piece of equipment and system. Each subcontractor or vendor responsible to execute a test, shall provide assistance to the CxA in developing the procedures and review. Prior to execution, the CxA shall provide a copy of the test procedures to the Subcontractors who shall review the tests for feasibility, safety, equipment and warranty protection. The CxA will submit the tests to the A/E for review.
 - 1. 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.
 - 2. The purpose of any given specific test is to verify and document compliance with the stated criteria of acceptance given on the test form.

- C. 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 data loggers.
- D. Simulating conditions (not by an overwritten value) shall be allowed, though timing the testing to experience actual conditions is encouraged wherever practical.
- E. Overwriting sensor values to simulate a condition, such as overwriting the outside air, shall be permitted. Simulating a condition is preferable. Before simulating conditions or overwriting values, sensors, transducers and devices shall have been calibrated.
- F. 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.
- G. Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test a sequence is acceptable.
- H. 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.
- I. Each function and test shall be performed under conditions that simulate actual conditions as close as is practically possible. The installing contractor 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 installing contractor shall return all affected building equipment and systems to their pre-test condition.
- J. The CM/GC shall provide a minimum of two weeks' notice to the CxA regarding its completion schedule for the pre-functional checklists and startup of all equipment and systems. The CxA will schedule functional performance tests through the CM/GC. The CxA shall coordinate, witness, and document the functional testing of all equipment and systems. The installing contractors shall execute the tests.
- K. Functional testing is conducted after pre-functional testing and startup has been satisfactorily completed. The control system is sufficiently tested and approved by the Engineer, Owner and CxA before it is used for TAB or to verify performance of other components or systems. The air balancing and water balancing (TAB) is completed, debugged, approved and TAB verification has been performed before functional testing of air-related or water-related equipment or systems.
- L. The CxA will recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the Contractors and A/E.
- M. Items identified as deficient during pre-functional testing and initial startup, but not corrected, that later cause deficiencies or delays during functional performance testing, will result in back charges to the CM/GC for the CxA's time to perform any retesting. The installing contractor shall be responsible for performing retests of deficient pre-functional or functional tests at its own cost.

3.8 SAMPLING AND FAILURE

- A. 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.
- B. Sampling by contractors is not permitted during pre-functional checklist execution unless otherwise permitted by the CxA or Owner.
- C. For sampling rates for TAB verification and functional performance testing refer to “Systems to be Commissioned” Section 1.5 above, the Cx Plan, and Division 22, 23 and 26.
- D. A common sampling strategy is the “xx% Sampling-yy% Failure Rule” where “xx = the percent of the group of identical equipment to be included in each sample” and “yy = the percent of the sample that if failing, will require another sample to be tested.
- E. For this project, the Failure Rule will be 10% or a minimum of two, whichever is greater
- F. An example of the “xx% Sampling-yy% Failure Rule” describing a 30% Sampling-10% Failure Rule:
 - 1. Randomly test at least 30% (xx) of each group of identical equipment. In no case test less than three units in each group. This 30%, or three, constitute the “first sample.”
 - 2. If 10% (yy) of the units in the first sample fail the functional performance tests, test another 30% 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. Any additional testing required beyond the first sample will be treated as a failure and the cost of the additional testing will be the responsibility of the Contractor as described in section 3.11.
 - 5. 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 installing contractor to perform and document a checkout of the remaining units, prior to continuing with functionally testing the remaining units.

3.9 DOCUMENTATION, NON-CONFORMANCE AND ACCEPTANCE OF TESTS

- A. Documentation: The CxA shall witness and document the results of selected quantities of functional performance tests using the specific procedural forms developed for that purpose. Prior to testing, these forms are provided to the CM/GC and the subcontractors for their review and use. The CxA will include the filled-out forms in the final commissioning report and 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 CM/GC, Owner, and A/E by through the commissioning issues log on MBPs cloud-based commissioning portal, CxAlloy, and through commissioning observation reports.

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 OPM.
 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 Contractor accepts responsibility to correct it:
 - 1) The CxA documents the deficiency and the Contractor's response and intentions and they go on to another test or sequence. After the day's work, the CxA reports the in the Commissioning Issues Log to the CM/GC, Subcontractor, Owner and A/E. The Contractor corrects the deficiency, provides a report of corrective action taken 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 in the Commissioning Issues Log with the Contractor's response and a copy given to the Owner, A/E, CM/GC and the Subcontractor 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 CxA, A/E and OPM. Final acceptance authority is with the OPM and A/E.
 - 3) The CxA documents the resolution process.
 - 4) Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency, provides a report of corrective action taken certifying that the equipment is ready to be retested and sends it back to the CxA. The CxA reschedules the test and the test is repeated until satisfactory performance is achieved.
 5. Cost of Retesting: Refer to Section 3.10 for details regarding costs/penalties for retesting.
 6. The Contractor shall respond in writing to the CxA and OPM at least as often as commissioning meetings are being scheduled concerning the status of each 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 report/form 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 a minimum of three, 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 OPM. In such case, the Contractor shall provide the Owner with the following:

1. Within one week of notification from the OPM, 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 A/E, CxA and OPM 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 OPM 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 OPM will be allowed to test the installations for up to one week, upon which the OPM 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. Acceptance: The CxA notes each satisfactorily demonstrated function on the test form. Formal acceptance of the functional test is made after review by the CxA, A/E and OPM, if necessary. The CxA recommends acceptance of each test to the OPM using the standard forms. The OPM gives final acceptance on each test using the same form, providing a signed copy to the CxA and the Contractor.

3.10 PENALTIES FOR RETESTING SYSTEMS OR EQUIPMENT

- A. The cost for the Contractor to retest a pre-functional or functional test shall be theirs.
- B. For a deficiencies identified, not related to any pre-functional checklist or startup fault, the following shall apply: The CxA will advise the OPM and A/E of the issue(s), who will then review and direct the CM/GC and their subcontractors as to corrective action to take and retesting of the equipment (including TAB verification). The cost for the CxA to perform one retest up to a total of 8 hours per (including travel time and expenses) will be performed at no "charge" to the CM/GC for their time. However, the CxA's time for a second retest/verification or testing totaling over 8 hours (including travel time and expenses) will be submitted as a change order to the Owner, who will assess the additional cost for the CxA against the CM/GC contract amount, and the CM/GC may choose to recover costs from the responsible subcontractor.
- C. The time for the CxA to oversee and coordinate any retesting required because a specific pre-functional checklist or startup test item, reported to have been successfully completed, but determined during functional testing to be faulty, will be submitted as a change order to the Owner, who will assess the additional cost for the CxA against the CM/GC contract amount, and the CM/GC may choose to recover costs from the responsible subcontractor.

3.11 OPERATION AND MAINTENANCE MANUALS

- A. CxA Review and Comment: Provide the CxA an electronic copy of the O&M manuals and redline as-builts for systems that were commissioned and other system documentation as determined by the CxA. Prior to substantial completion, the CxA shall review the O&M manuals, documentation and redline as-builts to verify compliance with the specifications. The CxA will communicate deficiencies in the manuals to the CM/GC, OPM and A/E, as required. The OPM or A/E shall direct the CM/GC and/or subcontractor to correct the deficiency as necessary and resubmit. Upon a successful review of the corrections, the CxA recommends acceptance of these sections of the O&M manuals to the OPM and 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.

3.12 TRAINING OF OWNER PERSONNEL

- A. The CM/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 commenting on the content and adequacy of the training of Owner personnel for commissioned equipment.
 - 1. The CM/GC shall interview the facility/maintenance manager 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 requirements to the CM/GC, subcontractors, and vendors who have training responsibilities. In addition to these general requirements, the specific training requirements of Owner personnel by Contractors and vendors is specified in Divisions 22, 23, 26, and 28.
 - 2. Each subcontractor and vendor responsible for training will submit a written training plan to the CxA, A/E and OPM for review and comment prior to training. The plan will cover the following elements:
 - a. Equipment (included in training)
 - b. Sign-in sheet.
 - c. Intended audience.
 - d. Location of training
 - e. Training Objectives.
 - f. Subjects covered (description, duration of discussion, special methods, etc).
 - g. Duration of training on each subject.
 - h. Methods (classroom lecture, video, site walk-through, actual operational demonstrations, written handouts, etc.).
 - i. Instructor qualifications.
 - j. For the primary HVAC equipment, the Controls Contractor shall provide a discussion of the control of the equipment during the mechanical or electrical training conducted by others.
 - 3. The CxA shall review and provide comments regarding the contractors overall training plan. The CM/GC shall coordinate and schedule the training for the commissioned systems with the Owner and CxA. The CxA and Owner develops criteria for determining that the training was satisfactorily completed. The CxA recommends acceptance of the training to the Owner if they feel the training meets the Contract Document requirements.

4. A sign-in sheet of attendees shall be submitted to the CxA for proof of training.
5. The mechanical design engineer shall be at the first training session and present the overall system design concept and the design concept of each equipment section. This presentation shall include a review of all systems using the simplified system schematics (one-line drawings) including cooling systems, heating systems, supply air systems, exhaust air systems and outside air strategies.
6. The electrical design engineer shall be at the first training session and present the overall system design concept and the design concept of each piece of commissioned equipment. This presentation shall include a review of all systems using simplified system schematics (one-line drawings) including the switchgear, panel boards, transformers, safety switches, emergency generator and lighting control system
7. Video recording of the training sessions shall be in accordance with the Contract Documents, and shall be provided by the CM/GC, with training session properly cataloged and burned to an approved electronic media. Provide high quality color on an approved electronic media. Training videos shall be added to the O&M manuals submitted to the Owner.

3.13 DEFERRED TESTING

- A. 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 Owner approval. These tests will be conducted in the same manner as the seasonal tests as soon as possible. Services of necessary parties will be required.
- B. Seasonal Testing: During the warranty period, seasonal testing (tests delayed until weather conditions are closer to the system's design) specified in Division 23 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 Subcontractors, with facilities staff and the CxA witnessing. Any final adjustments to the O&M manuals and as-builts due to the testing will be made.

3.14 SAMPLE PRE-FUNCTIONAL CHECKLISTS

- A. See Commissioning Plan Appendix A

3.15 SAMPLE FUNCTIONAL PERFORMANCE TESTS

- A. See Commissioning Plan Appendix B

END OF SECTION 019113

**SECTION 024100
DEMOLITION**

PART 1 GENERAL

1.01 DEFINITIONS

- A. "Remove": Carefully detach or dismantle items from existing construction and properly dispose of or recycle off site, unless items are indicated to be salvaged or reinstalled.
- B. "Salvage" or "Remove and Salvage": Carefully detach or dismantle items from existing construction in a manner to prevent damage. Clean, package, label and deliver salvaged items to Owner in ready-for-reuse condition. If indicated to be reinstalled, store in a secure area until ready for reinstallation.
- C. "Reinstall" or "Remove and Reinstall": Carefully detach or dismantle items from existing construction in a manner to prevent damage. Clean and prepare for reuse and reinstall where indicated.
- D. "Existing", "Existing to Remain" or "ETR": Designation for existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
 - 1. Not all existing construction to remain shall be noted with one of these terms on the Drawings; the intent is to assist the Contractor in areas where it may be difficult to determine. Existing construction shall be assumed to remain unless specifically noted to be removed - either when noted with "remove", "salvage", or "reinstall" terminology per above, or when indicated graphically in accordance with the Demolition Legend on the Demolition Drawings.

1.02 REFERENCE STANDARDS

- A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting not less than one week before starting work of this section; require attendance by all affected installers.
 - 1. Hold the preinstallation meeting at the Project site; perform a walkthrough to review the existing conditions and highlight areas of particular concern.
 - 2. Review structural concerns and deficiencies in the existing building(s).
 - 3. Review demolition schedule, including phasing.
 - 4. Review specific elements indicated to remain or to be salvaged, and review procedures for protection and / or storage of those elements.
 - 5. Review Owner's occupancy and noise requirements.
- B. Coordination: Coordinate staging requirements with Owner's occupancy of the existing building.
 - 1. Coordinate with Division 01 sections for Owner's occupancy and noise requirements.
 - 2. Owner's personnel shall remove existing equipment and furnishings from spaces to be demolished prior to the beginning of the Work. Except for any built-in equipment specifically indicated on the Drawings to remain and be protected, the Contractor will not be required to work in furnished areas and will not be responsible for the condition of furniture or equipment left in place.

1.04 SUBMITTALS

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- A. Photographic Documentation: Submit photographic record of the existing conditions, either as still photographs or as a video-recorded walkthrough. Contractor shall perform walkthrough of existing conditions with Owner's representative prior to site mobilization.
 - 1. Photographic documentation shall clearly show existing damage and wear on existing surfaces that may be interpreted as being caused by subsequent demolition and construction operations.
 - 2. For still photographs, submit marked-up plan(s) indicating locations where photographs were taken and direction photograph is facing. Include a written narrative to describe existing damage and other conditions as deemed necessary.
 - 3. For video recordings, include a spoken narrative to describe locations and existing conditions, or provide a supplementary written narrative.
 - 4. Submit all photographic documentation as digital photo / video files, and supplementary narratives and plans as PDF files. Submit as part of the initial submittal package required prior to release of the first request for payment.
- B. Shop Drawings: Submit demolition plans and survey as required by OSHA and local AHJs.
 - 1. Engineering Survey: Provide structural survey of existing building(s). Provide additional surveys if unforeseen conditions are revealed during the course of the Work.
 - 2. Indicate extent of demolition, removal sequencing, bracing and shoring, and location and construction of barricades and fences.
 - 3. Indicate elements to be salvaged and elements that are to remain in place and protected.
- C. Refrigerant Certification: Provide a written statement, signed by refrigerant recovery technician, certifying that refrigerant materials were recovered in accordance with EPA regulations. Statement shall include certified technician's full name and business name as applicable, address, and date of recovery.
- D. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.05 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Technicians removing or disposing of any equipment or appliance containing ozone-depleting refrigerants shall be certified in accordance with EPA Section 608 Technician Certification.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.01 EXAMINATION

- A. Perform an initial walkthrough and visual survey of the existing building(s). Take photographic documentation of the existing conditions per submittal requirements above.
- B. Perform structural engineering survey of the existing conditions as required by OSHA and local AHJs.

3.02 PREPARATION

- A. Remove and salvage items indicated to be reinstalled or turned over to Owner. Clean items and protect in secure packaging, and store in a secure location on-site.

3.03 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. All demolition work shall be considered unclassified. Barring discovery of hazardous materials or undocumented structural components, where elements are indicated to be demolished, the bid price shall be for complete demolition of the element, regardless of the individual component makeup of that element.
- B. Refrigerant Recovery: Certified recovery technician shall remove refrigerant from all applicable equipment and appliances prior to the start of demolition activities.
- C. Hazardous Materials: It is not expected that hazardous materials will be encountered during performance of the Work.
 - 1. If suspected hazardous materials are discovered during demolition operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCBs, and mercury.
- D. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 - 1. Obtain required permits.
 - 2. Fire Safety: Comply with applicable requirements of the International Fire Code; Chapter 33, and with NFPA 241.
 - a. Use of explosives is not permitted.
 - b. Hot Work: Remove all combustibles from areas where hot work is required, including use of cutting torches, welding, or heating equipment. Maintain fire watch for entire duration of hot work and for a minimum 30 minutes after completion of hot work.
 - 1) Keep portable fire extinguishers within 30 feet of locations where hot work is being performed for entire duration.
 - c. Maintain egress routes and emergency access routes at all times; do not allow demolished materials to accumulate and block routes.
 - d. Remove combustible demolished materials from the building by the end of each work day. Temporarily store combustible materials in noncombustible containers with self-closing lids until they can be removed from the building.
 - e. Do not burn demolished material on site.
 - 3. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
 - 4. Provide, erect, and maintain temporary barriers and security devices.
 - 5. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 - 6. Do not close or obstruct roadways or sidewalks without permits from authority having jurisdiction.
 - 7. Conduct operations to minimize obstruction of public and private entrances and exits. Do not obstruct required exits at any time. Protect persons using entrances and exits from removal operations.
 - 8. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon, or limit access to their property.
- E. Do not begin removal until receipt of notification to proceed from Owner.
- F. Do not begin removal until built elements to be salvaged, relocated, or reinstalled have been removed.
- G. Protect existing structures and other elements to remain in place and not removed.
 - 1. Provide bracing and shoring.

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2. Prevent movement or settlement of adjacent structures.
3. Stop work immediately if adjacent structures appear to be in danger.
- H. Minimize production of dust due to demolition operations. Do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- I. Perform demolition in a manner that maximizes salvage and recycling of materials.
 1. Comply with requirements of Section 017419 - Construction Waste Management and Disposal.
 2. Dismantle existing construction and separate materials.
 3. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.
- J. If items of potential historic interest are discovered during the course of the Work, such as cornerstones or plaques, consult with the Owner prior to proceeding. If Owner wishes to preserve these items, carefully remove and salvage, and store in on-site location designated by Owner.

3.04 EXISTING UTILITIES

- A. Coordinate work with utility companies. Notify utilities before starting work, comply with their requirements, and obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

3.05 SELECTIVE DEMOLITION FOR ALTERATIONS

- A. Existing construction and utilities indicated on drawings are based on casual field observation and existing record documents only.
 1. Verify construction and utility arrangements are as indicated.
 2. Report discrepancies to Architect before disturbing existing installation.
 3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Separate areas in which demolition is being conducted from areas that remain occupied.
 1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 015000 in locations indicated on drawings.
- C. Maintain weatherproof exterior building enclosure, except for interruptions required for replacement or modifications; prevent water and humidity damage.
- D. Protect existing work to remain.
 1. Prevent movement of structure. Provide shoring and bracing as required.
 2. Perform cutting to accomplish removal work neatly and as specified for cutting new work.

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3. Repair adjacent construction and finishes damaged during removal work.
4. Patch to match new work.
- E. Remove existing work as indicated and required to accomplish new work.
 1. Remove items indicated on drawings.
- F. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
 1. Maintain existing active systems to remain in operation, and maintain access to equipment and operational components.
 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 3. Coordinate with Section 011000 - Summary for limitations on outages and required notifications to Owner, as applicable.
 4. Verify that abandoned services serve only abandoned facilities before removal.
 5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings. Remove back to source of supply where possible, otherwise cap stub and tag with identification.
- G. Floor Finishes: After removal of existing floor finishes including backings, underlayments, and thick set mortar beds, remove all residual adhesives and glue. Provide grinding, sanding, or shot-blasting of existing concrete floor slab to achieve the proper surface to receive new indicated floor finish. Coordinate slab surface preparations required for each new indicated floor finish with appropriate subcontractor.
- H. Carpet: Coordinate with Division 9 carpet manufacturer and Division 1 Construction Waste Management section for recycling of existing sheet or tile carpet. Remove carpet carefully and remove all loose debris and metal (tacks, nails, stretcher strips). Coordinate with Carpet and Rug Institute guidelines for removal and disposal of adhesives. Cut sheet carpeting and carpet padding into four foot sections and tightly roll and wrap. Stack carpet tile on 36 inch or smaller pallets, no higher than 4 feet, and shrink wrap. Store in a protected, dry location in preparation for delivery to reclamation/recycling facility.
- I. Acoustical Ceiling Panels: Coordinate with Division 9 acoustical ceiling panel manufacturer and Division 1 Construction Waste Management section. Remove ceiling tiles and stack neatly on pallets; wrap or band pallet loads. Store in a protected, dry location in preparation for delivery to recycling facility.
- J. Concrete: Cut neatly in straight lines with power-driven saw with diamond-tooth blade or other type specifically intended for concrete and masonry. Break up and remove carefully, avoiding damage to adjacent flooring that will remain exposed in the finished work.
- K. Masonry: Remove masonry in whole units at exposed surfaces, new openings, and unless otherwise indicated, to allow for toothing-in of new masonry.
 1. Solid masonry may be cut with power saw where masonry edges will be concealed by the finished work. Do not cut hollow masonry.
- L. Existing Surfaces to Receive Finishes: Remove miscellaneous hangers, exposed nails not serving as fasteners, and similar protrusions; remove adhesive residue and tape; fill anchorage holes; and otherwise patch and restore surface to be a uniform substrate suitable for applied finishes.

3.06 DEBRIS AND WASTE REMOVAL

- A. Comply with requirements of 017419 - Construction Waste Management and Disposal.
-

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- B. Remove all debris, trash, and other materials not indicated to be salvaged or reinstalled from the site.
- C. Leave site in clean condition, ready for subsequent work.
- D. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION 024100

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUMMARY

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

1.3 DEFINITIONS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.
 - 1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.
- E. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - 1. Location of construction joints is subject to approval of the Architect.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For installer, manufacturer, testing agency.
- B. Welding certificates.
- C. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Fiber reinforcement.
6. Waterstops.
7. Curing compounds.
8. Floor and slab treatments.
9. Bonding agents.
10. Adhesives.
11. Vapor retarders.
12. Semirigid joint filler.
13. Joint-filler strips.
14. Repair materials.

- D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- E. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
- F. Field quality-control reports.
- G. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
1. Personnel conducting field tests shall be qualified as ACI Concrete Field-Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."

- F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specifications for Structural Concrete."
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- H. Preinstallation Conference: Conduct conference at Project site.
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.
 - e. Special concrete finish subcontractor.
 - f. Architect/EOR.
 - 2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, vapor-retarder installation, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Plywood, metal, or other approved panel materials.
 - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. High-density overlay, Class 1 or better.
 - b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
 - c. Structural 1, B-B or better; mill oiled and edge sealed.
 - d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

- D. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- E. Form Ties: Factory-fabricated, removable, or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
 - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade, deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- C. Plain-Steel Wire: ASTM A 82/A 82M, as drawn.
- D. Plain-Steel Welded Wire Reinforcement: ASTM A 1064, plain, fabricated from as-drawn steel wire into flat sheets.

2.3 REINFORCEMENT ACCESSORIES

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

2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type I, Type II, or Type I/II. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class F.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Silica Fume: ASTM C 1240, amorphous silica.
- C. Normal-Weight Aggregates: ASTM C 33. Provide aggregates from a single source.
 - 1. Maximum Coarse-Aggregate Size: As indicated on drawings.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Light-Weight Aggregates: ASTM C-330. "Solite" or "Stalite" expanded shale aggregate produced by rotary kiln method acceptable to the Structural Engineer or approved equal.

- E. Water: ASTM C 94/C 94M and potable.

2.5 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.6 FIBER REINFORCEMENT

- A. Synthetic Macro-Fiber: Polyolefin macro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, 1 to 2-1/4 inches long.

2.7 VAPOR BARRIERS

- A. Sheet Vapor Barrier: ASTM E 1745, Class A, with a permeance of less than 0.01 perms after mandatory conditioning (ASTM E1745, Section 7.1). Include manufacturer's recommended mastic, pressure-sensitive tape, and accessory materials.
- B. Granular Fill: Granular, densely graded "crusher run" material with a balanced fine content, such as NCDOT ABC Stone, GAB, OR 21A or 21B. The base course shall be compacted and shall be finished to a flat, smooth, low-friction surface.

2.8 LIQUID FLOOR TREATMENTS

- A. VOC Content: Liquid floor treatments shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Penetrating Liquid Floor Treatment (CONC-LH): Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.
- C. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound (CONC-SLR): ASTM C 1315, Type 1 Class A.

2.9 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

2.10 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- C. Reglets: Fabricate reglets of not less than 0.022-inch thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- D. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.11 REPAIR MATERIALS

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

2.12 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 1. Fly Ash: 25 percent.
 2. Ground Granulated Blast-Furnace Slag: 25 percent.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.
 1. Use high-range water-reducing admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

2.13 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Footings: Proportion normal-weight concrete mixture as follows:
 1. Minimum Compressive Strength: As indicated.
 2. Slump Limit: 4 inches, or 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
 3. Air Content: As indicated.
 4. Maximum Water/Cement Ratio: As indicated.
- B. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:
 1. Minimum Compressive Strength: As indicated.
 2. Slump Limit: 5 inches, plus or minus 1 inch.
 3. Air Content: As indicated.
 4. Maximum Water/Cement Ratio: As indicated.
- C. Piers: Proportion normal-weight concrete mixture as follows:
 1. Minimum Compressive Strength: As indicated.
 2. Slump Limit: 4 inches, or 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture.
 3. Air Content: As indicated.
 4. Maximum Water/Cement Ratio: As indicated.
- D. Air Content: Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content as indicated with a tolerance of plus 1 or minus 1.5 percent, for exterior concrete only, unless otherwise indicated.

2.14 FABRICATING REINFORCEMENT

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

2.15 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
 - 1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 - 2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
 - 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK

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

- J. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- K. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

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

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F 24 hours after placing concrete. Concrete shall be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
 - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
 - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 VAPOR BARRIERS

- A. Sheet Vapor Barriers: Place, protect, and repair sheet vapor barrier according to ASTM E 1643 and manufacturer's written instructions.
 - 1. Lap joints 6 inches and seal with manufacturer's recommended tape. Seal to all penetrations and vertical surfaces.

3.5 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

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

3.6 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- C. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
 - 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
 - 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- D. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.7 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in position on chairs during concrete placement.
 - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 4. Slope surfaces uniformly to drains where required.
 - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- G. Hot-Weather Placement: Comply with ACI 301 and as follows:
 - 1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.8 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete.
- C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
 1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
 2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one-part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.9 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.
 1. Apply scratch finish to surfaces indicated and to receive concrete floor toppings and to receive mortar setting beds for bonded cementitious floor finishes.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
 1. Apply float finish to surfaces indicated, to surfaces to receive trowel finish and to surfaces to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces indicated and to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:
 - a. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17.
 - b. At slabs used as casting beds for wall panels, specified overall values of flatness, F(F) 50; and of levelness, F(L) 35; with minimum local values of flatness, F(F) 40; and of levelness, F(L) 24.
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated and to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
 1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.10 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations:
 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
 2. Minimum Compressive Strength: 3500 psi at 28 days.
 3. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 4. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete substrate.
 5. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 6. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.11 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
 - 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.
 - 5. Terrazzo Floor Areas: At areas to receive terrazzo flooring, cure concrete for a minimum of 28 days. Do not use curing agents in areas to receive terrazzo flooring.

3.12 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least six month(s). Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.13 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry pack patching mortar, consisting of one-part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 - 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 - 2. After concrete has cured at least 14 days, correct high areas by grinding.
 - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 - 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's

written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.14 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
 5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 6. Compression Test Specimens: ASTM C 31/C 31M.

- a. Cast and laboratory cure one set of five standard cylinder specimens for each composite sample.
 7. Compressive-Strength Tests: ASTM C 39/C 39M; test one laboratory-cured specimen at 7 days and one set of three specimens at 28 days and hold one specimen for test at 56 days.
 - a. A compressive-strength test shall be the average compressive strength from a set of three specimens obtained from same composite sample and tested at age indicated.
 8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
 9. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
 10. 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.
 11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that temperature, batch to placement time, slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
 12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- C. Measure floor and slab flatness and levelness according to ASTM E 1155 within 24 hours of finishing.

END OF SECTION 033000

SECTION 033543
POLISHED CONCRETE FINISHING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ANSI/NFSI B101.1 - Test Method for Measuring the Wet SCOF of Hard-Surface Walkways.
- B. ANSI/NFSI B101.3 - Test Method for Measuring the Wet DCOF of Hard Surface Walkways.
- C. ASTM C1353/C1353M - Standard Test Method for Abrasion Resistance of Dimension Stone Subjected to Foot Traffic Using a Rotary Platform Abraser.
- D. ASTM D4039 - Standard Test Method for Reflection Haze of High-Gloss Surfaces.
- E. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
- F. ASTM D5767 - Standard Test Method for Instrumental Measurement of Distinctness-of-Image (DOI) Gloss of Coated Surfaces.
- G. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.
- H. ASTM G154 - Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate work of this section with concrete floor placement and concrete floor curing.
- B. Preinstallation Meeting: Conduct a preinstallation meeting 10 days prior to start of any concrete work. Preinstallation meeting for this section may be combined with preinstallation meeting for concrete per Section 033000 "Cast-in-Place Concrete." Conduct meeting at the Project site.
 - 1. Items for Review:
 - a. Contract document requirements.
 - b. Approved submittals and mock-up requirements, including location and timing of test areas/mock-ups.
 - c. Physical requirements of concrete slab and slab finish, including specific mix design(s), specified compressive strengths, and floor flatness requirements.
 - d. Curing methods.
 - e. Polished concrete finish requirements.
 - f. Protection of surfaces not scheduled for finish application.
 - g. Surface preparation.
 - h. Application procedure, including details of each step of grinding, honing, and polishing operations, application of liquid applied products, and quality control.
 - i. Procedures for edges and penetrations.
 - j. Cleaning, including proper disposal of concrete slurry and concrete dust.
 - k. Methods of protection of polished concrete floors during construction and after completion of polishing work, including coordination with all trades to clarify requirements and responsibilities.
 - l. Coordination with other work.
 - 2. Require attendance of parties directly affecting work of this section, including:
 - a. Concrete producer's technical representative.

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- b. Concrete installer.
 - c. Concrete polishing contractor.
 - d. General Contractor's representative.
 - e. Contractor's representative.
 - f. Architect.
 - g. Structural engineer.
 - h. Owner's representative.
3. Notify parties one week in advance of date and time of meeting.

1.03 SUBMITTALS

- A. Product Data:
 - 1. Submit manufacturers specifications, technical data, test data, and written recommendations for storage, preparation, application and curing for each type of product indicated.
 - 2. Submit manufacturer's Material Safety Data Sheet (MSDS) and other safety requirement for each type of manufactured material and product indicated.
- B. Submit Polishing Contractor's recommended installation procedures which, when reviewed by the Architect, may become the basis for accepting or rejecting actual installation procedures used on the work.
- C. Samples for initial selection, approximately 12-inches x 12-inches x 2-inches, to illustrate finished surfaces of polished concrete.
- D. Manufacturer's Certification: Letter of certification from product manufacturer stating that installer is a certified applicator and is familiar with proper procedures and installation requirements required by the manufacturer.
- E. Concrete Polishing Contractor Qualifications:
 - 1. Provide letter of certification from the Concrete Polishing Council (CPC) stating that installer is a certified applicator of special concrete finishes.
 - 2. Submit a list of previous projects similar to this project in design, extent, and scope.

1.04 QUALITY ASSURANCE

- A. Concrete Polishing Contractor Qualifications:
 - 1. Shall be a company that has expertise in this type of work, sufficient production capability, successful completion of at least five projects similar to this project in size, and scope.
 - 2. Shall have an adequate number of personnel trained and experienced in this type of work, and shall have an on-site supervisor who is currently certified as Concrete Polishing Craftsman by the Concrete Polishing Council (CPC).
 - 3. Shall be approved/certified by the manufacturer for application of the liquid applied products.
 - 4. Shall be familiar with the specified requirements and the methods needed for proper performance of work of this Section.

1.05 MOCK-UP

- A. Construct mock-ups of each type finish, to demonstrate surface finish, color variation, typical joints, and standard of workmanship.
- B. Cast concrete slab mock-ups approximately 10 ft x 10 ft in the location indicated or if not indicated, as directed by the Architect.

- C. Placement, grinding, and polishing work shall be performed by the same personnel who will be doing this work on the Project.
- D. Notify Architect seven days in advance of dates and times when mock-ups will be constructed, when practical.
- E. Obtain approval of mock-ups from the Architect before starting actual work. If the Architect determines the mock-ups do not meet requirements, demolish and remove them from the site and cast others until mock-ups are approved.
- F. Maintain approved mock-ups during construction in an undisturbed condition as a standard for judging the completed work.
- G. When approved by Architect, approved mock-ups may remain as part of the finished work if undamaged and clean at time of Substantial Completion.

1.06 PROTECTION

- A. Prevent petroleum or rust stains on concrete slab. No satisfactory chemical or cleaning procedure is available to remove petroleum and rust stains from the concrete surface. Prevention is therefore essential.
- B. All equipment shall be diapered to avoid staining of the concrete from petroleum, oil, hydraulic fluid, or other liquid dripping from equipment over concrete surfaces.
- C. Do not allow trades to park vehicles on the interior floor slab. If vehicles must be driven on interior slabs, drop cloths shall be placed under vehicles at all times.
- D. Do not allow pipe cutting machine to be used or set up on the interior floor slab.
- E. Steel, cans, and steel containers shall not be placed on interior slab, to avoid rust staining.
- F. All equipment must be equipped with non-marking tires.
- G. Equipment with soft rubber tires prone to picking up screws and nails shall be equipped with canvas tire bags.
- H. Slabs subject to masonry construction, mortar spoils, pallet movers, forklifts, and scaffolding shall be protected with a breathable product and plywood or OSB until all masonry operations are complete.
- I. Do not tape protective coverings to concrete.
- J. Prohibit use of markers, spray paint and soap stone.
- K. Protect from painting activities over interior floor slab.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's sealed packaging, including application instructions.
- B. Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture or other detrimental effects.
- C. Dispense special concrete finish material from factory numbered and sealed containers. Maintain record of container numbers.

1.08 FIELD CONDITIONS

- A. Ambient Conditions: Verify that field conditions are within manufacturer's allowable range prior to application.

PART 2 PRODUCTS

2.01 MATERIALS AND MANUFACTURERS

- A. Concrete Stain: Translucent/semi-transparent, penetrating compound for interior or exterior use.
 - 1. Number of Coats: Two spray-applied coats, unless otherwise indicated.
 - 2. VOC: 50 g/L or less.
 - 3. Color: Shall be selected by Architect from manufacturer's standard range.
 - 4. Composition: Water-based, nonreactive.
 - a. Products:
 - 1) Ameripolish, Inc; Surelock Concrete Dye.
 - 2) Euclid Chemical Company; Increte Vibra-Stain.
 - 3) H&C Products Group; Infusion Water-Based Semi-Transparent Decorative Stain.
 - 4) PROSOCO, Inc; GemTone Stain.
 - 5) Sika; Scofield Formula One Liquid Dye.
 - 6) Substitutions: See Section 016000 - Product Requirements.
- B. Penetrating Liquid Floor Treatment (Densifier and Stain Resistance): Penetrating chemical compound that reacts with concrete, filling the pores and hardening, and dustproofing. Colorless, odorless, and zero VOC. Breathable treatment which permits moisture transmission through concrete.
 - 1. Composition: Lithium silicate.
 - 2. Abrasion Resistance: Greater than 50 percent improvement compared to untreated sample in accordance with ASTM C1353/C1353M.
 - 3. Treated Material Slip Resistance: High traction range when tested according to ANSI/NFSI B101.1 and ANSI/NFSI B101.3.
 - 4. Adhesion: Greater than 10 percent increase in pull-off strength compared to untreated sample when tested according to ASTM D4541.
 - 5. Water Vapor Transmission: Zero perms compared to untreated sample when tested according to ASTM E96/E96M Method B.
 - 6. UV Stability: No degradation or yellowing when tested in accordance with ASTM G154.
 - 7. Products:
 - a. Bomanite Corporation; Stabilizer Pro.
 - b. Euclid Chemical; Ultrasil LI+.
 - c. Laticrete International; L&M FGS Hardener Plus.
 - d. Sika; Scofield Formula One Lithium Densifier.
 - e. Substitutions: See Section 016000 - Product Requirements.

2.02 RELATED MATERIALS

- A. Water: Clean and potable.

PART 3 EXECUTION

3.01 EXAMINATION AND PREPARATION

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- A. Examine substrate, with concrete base slab installer and Concrete Polishing Contractor present, for conditions affecting performance of finish. Correct conditions detrimental to timely and proper work. Do not proceed until unsatisfactory conditions are corrected.
- B. Verify that base slab meets requirements of Division 3 Section "Cast-In-Place Concrete."
 - 1. Finished floor flatness.
 - 2. Curing methods.
 - 3. Compressive strength.
- C. Verify that surface is free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, residues from cleaning agents, and other impediments to installation of stain and sealer products.
 - 1. At existing slabs, verify that all existing flooring and accessories including adhesive residue are fully removed and cleaned prior to start of polishing process.

3.02 APPLICATION

- A. Prepare floor for hardener-sealer application with specified diamond grinding steps, followed by the application of hardener-sealer and final polishing steps.
- B. Apply stain prior to hardener-sealer for maximum penetration of substrate.
- C. Machine grind floor surfaces to receive polished finishes level and smooth, and to depth required to reveal aggregate to exposure Class A - Cement Fines; cement fines, 85 to 95 percent; fine aggregates, 5 to 15 percent; per Concrete Polishing Council aggregate exposure guidelines, and to match approved mockup.
- D. Polish interior slabs to Level 2 - Satin, image clarity value 10 to 39 percent per Concrete Polishing Council appearance guidelines, and to match approved mockup.
 - 1. Image Clarity: Image clarity value per above value shall be measured in accordance with ASTM D5767; prior to application of sealer (if applicable).
 - 2. Haze Index: Haze index average less than 10 shall be measured in accordance with ASTM D4039; prior to application of sealer (if applicable).
- E. Hardening and Polishing of Concrete Surface:
 - 1. Concrete must be in place a minimum of 28 days or as directed by the manufacturer before application can begin.
 - 2. Only a certified applicator shall apply hardener. Applicable procedures shall be followed as recommended by the product manufacturer and as required to match approved test sample.
 - 3. Apply hardener for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.
 - 4. Achieve waterproofing, hardening, dust-proofing and abrasion resistance of the surface without changing the natural appearance of the concrete, except for the sheen.
 - 5. Finish to within 1/2-inch of vertical surfaces.
 - 6. Properly dispose of collected dry dust from polishing.

3.03 WORKMANSHIP AND CLEANING

- A. Maintain polished concrete clean and free of stains and debris
- B. Remove spatter from adjoining surfaces.
- C. Repair damage to adjacent surfaces caused by cleaning operations.
- D. Dispose of materials in accordance with local regulations.

- E. Grind and polish in multiple passes with each full pass in direction perpendicular to previous pass.
- F. Fill gaps, voids, and pop-outs during grinding operation.

3.04 PROTECTION

- A. Final Protection of Polished Concrete:
 - 1. Following completion of the final polishing, surface shall be covered to protect from other trades. Cover with breathable product, such as Kraft paper or thin curing blanket. Do not cover with Masonite, plywood, or polyethylene.
 - 2. Do not allow wheeled equipment or vehicles onto concrete after polishing is complete.
- B. Clean spills on slab surfaces immediately, with manufacturer's recommended chemicals and absorptive materials.
- C. No haze, white residue, streaking, or burnish marks permitted.

END OF SECTION 033543

**SECTION 042000
UNIT MASONRY**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ACI SP-66 - ACI Detailing Manual.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- C. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
- D. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement.
- E. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.
- F. ASTM C33/C33M - Standard Specification for Concrete Aggregates.
- G. ASTM C55 - Standard Specification for Concrete Building Brick.
- H. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units.
- I. ASTM C91/C91M - Standard Specification for Masonry Cement.
- J. ASTM C140/C140M - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
- K. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar.
- L. ASTM C151 - Standard Test Method for Autoclave Expansion of Hydraulic Cement.
- M. ASTM C270 - Standard Specification for Mortar for Unit Masonry.
- N. ASTM C331/C331M - Standard Specification for Lightweight Aggregates for Concrete Masonry Units.
- O. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.
- P. ASTM C476 - Standard Specification for Grout for Masonry.
- Q. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.
- R. ASTM C618 - Standard Specification for Coal Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
- S. ASTM C641 - Standard Test Method for Iron Staining Materials in Lightweight Concrete Aggregates.
- T. ASTM C780 - Standard Test Methods for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
- U. ASTM C1019 - Standard Test Method for Sampling and Testing Grout for Masonry.
- V. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
- W. NCMA TEK 08-04A - Cleaning Concrete Masonry.
- X. NCMA TEK 12-01B - Anchors and Ties for Masonry.
- Y. NCMA TEK 12-02B - Joint Reinforcement for Concrete Masonry.
- Z. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting at the Project site one week before starting work of this section; require attendance by all relevant installers.

1.03 SUBMITTALS

- A. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.
 - 1. Installation Instructions for Cold- and Hot-Weather: Provide a detailed description of the procedures that will be used to comply with TMS 402/602 for cold- and hot-weather, including materials and equipment that will be used.
- B. Shop Drawings: Indicate pertinent dimensions, materials, anchorage, size and type of fasteners, and accessories, for each type of masonry.
 - 1. Provide elevations indicating steel reinforcing bar locations; provide details of reinforcing including bends and cross-sections, in accordance with ACI SP-66.
 - 2. Indicate control and expansion joint locations.
 - 3. Provide flashing details indicating corners, end dams, and other special conditions.
- C. Material Certificates and Test Reports: Provide manufacturer's certificates and test reports for the following:
 - 1. Masonry Units:
 - a. Masonry Units: Compressive strength test data.
 - b. Concrete Masonry: Data indicating aggregates comply with ASTM C33/C33M (normal weight), ASTM C331/C331M (lightweight), and ASTM C618 (fly ash).
 - 2. Mortar and Grout Mixes: Provide description and proportion of materials for each type of mortar and grout.
 - 3. Provide material certificates for each type of metal accessory, including reinforcing bars, joint reinforcement, veneer ties and anchors, and other indicated accessories, indicating compliance with requirements.
- D. Cold- and Hot-Weather Procedures: Provide a detailed description of the procedures that will be used to comply with TMS 402/602 for cold- and hot-weather, including materials and equipment that will be used.
- E. Installer's Qualification Statement.

1.04 QUALITY ASSURANCE

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
- B. Fire Rated Assemblies: Provide products that comply with fire-resistance ratings indicated as determined by testing according to ASTM E119, by equivalent testing thickness, or by means acceptable to authorities having jurisdiction.
- C. Source Limitations for Masonry: Provide each type of masonry unit from a single manufacturer's plant, sourced through a single supplier. Each type of masonry unit shall maintain consistency of color and texture for all product required on the entire project. The approved mockup/sample panel shall be used to determine acceptable color and texture range.
- D. Source Limitations for Mortar: Provide each mortar mix from a single manufacturer, sourced through a single supplier. Each required mortar mix shall maintain consistency of each component, including cementitious materials and aggregate, to provide consistent color and texture for all product required on the entire project. The approved mockup/sample panel shall be used to determine acceptable color and texture range.

- E. Aggregate for Concrete Masonry Units: If bottom ash is used as aggregate in the CMU, the Source for the bottom ash shall be a power station that has a minimum of ten (10) years continuous experience as a supplier of quality material as verified by independent certified laboratory testing and no defects in the marketplace.
- F. Pre-Construction Testing: Owner shall engage an independent testing agency to perform field quality control tests, in accordance with Section 014000 - Quality Requirements.
 - 1. Concrete Masonry Unit Tests: Testing agency shall test each variety of concrete unit masonry in accordance with ASTM C140/C140M compressive strength requirements.

1.05 FIELD CONDITIONS

- A. Cold- and Hot-Weather Requirements: Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS

- A. Concrete Block: Comply with referenced standards and as follows:
 - 1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depths as indicated on drawings for specific locations.
 - 2. Special Shapes: Provide nonstandard blocks configured for corners, lintels, headers, other detailed conditions, and as indicated below.
 - a. Provide bullnose units for outside corners.
 - b. Provide solid block with bullnosed top edges at free-standing CMU walls and where top of block is exposed at window sills and similar applications.
 - 3. Concrete Masonry Units: ASTM C90, lightweight.
 - a. Exposed Faces: Manufacturer's standard color and texture.
 - b. Aggregates:
 - 1) Lightweight Aggregates: Lightweight aggregate shall strictly comply with ASTM C331/C331M, ASTM C151, and ASTM C641. Drying shrinkage of aggregate shall not exceed 0.10% at 100 days.
 - 2) Waste concrete, scoria, and aglite shall not be permitted.
- B. Concrete Brick:
 - 1. Actual Size: 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long.
 - 2. Concrete Building Brick: ASTM C55; lightweight, solid, for interior or concealed use.

2.02 MORTAR AND GROUT MATERIALS

- A. Masonry Cement: ASTM C91/C91M.
- B. Mortar Aggregate: ASTM C144.
- C. Grout Aggregate: ASTM C404.
- D. Water: Clean and potable.
- E. Accelerating Admixture: ASTM C494/C494M, Type C; nonchloride, noncorrosive type for use in cold weather; approved by manufacturer for use in masonry mortar.

2.03 REINFORCEMENT AND ANCHORAGE

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi), deformed billet bars; uncoated.
- B. Joint Reinforcement, Anchorage, and Ties, General: Comply with NCMA TEK 12-02B, NCMA TEK 12-01B, and requirements below.
 - 1. Use ladder type joint reinforcement, unless otherwise indicated. Truss type reinforcement may be used only when approved by Architect, at walls indicated not to have vertical reinforcing steel and not to be grouted.
 - 2. Provide prefabricated joint reinforcement sections for corners and for T-intersections.
 - 3. Provide joint reinforcement in minimum 10 foot lengths.
 - 4. At multi-wythe/cavity wall applications, size all anchors, ties, and reinforcement for depths of cavities indicated, including indicated insulation thickness as applicable. Ties shall maintain full adjustability at veneer wythe without affecting insulation.
 - 5. At cavities with space between wythes wider than 4-1/2 inches (air space + insulation depth), provide high strength ties engineered for cavity depths indicated.
- C. Single Wythe Joint Reinforcement: ASTM A951/A951M.
 - 1. Material: Mill-galvanized steel for interior walls, hot-dip galvanized steel for exterior walls.
 - 2. Size: 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not less than 5/8 inch of mortar coverage on each exposure.
- D. Strap Anchors: Bent steel shapes, 1-1/2 inch width, 0.105 inch thick, 24 inch length, with 2 inch long, 90 degree bend at each end to form a U or Z shape or with cross pins, hot dip galvanized to ASTM A153/A153M Class B.
- E. Flexible Anchors: 2-piece anchors that permit differential movement between masonry and building frame, sized to provide not less than 5/8 inch of mortar coverage from masonry face.
 - 1. For Anchorage to Structural Steel Framing: Crimped wire anchors for welding to frame, 0.25 inch thick, with triangular/trapezoidal wire ties 0.1875 inch thick, hot dip galvanized to ASTM A 153/A 153M, Class B.
- F. Metal-to-Metal Fasteners (for Steel Studs): Self-drilling, self-tapping #10 hex screws; fabricated of either 304 stainless steel or of steel with corrosion resistant polymer coating tested to ASTM B117. Fasteners shall include integral neoprene or EPDM washer.
 - 1. Products:
 - a. ELCO Construction Products; Dril-Flex with Stalgard Finish.
 - b. Heckmann Building Products; #668 TEK Self-Drilling Steel Stud Screw.
 - c. ITW Commercial Construction North America; Teks Maxiseal with Climaseal Finish, or Scots Long Life Teks (stainless steel).

2.04 ACCESSORIES

- A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.
 - 1. Provide nominal 2.5-inch "standard" and "tee" configurations to suit application unless indicated otherwise.
- B. Joint Filler: Closed cell polypropylene or non-chlorinated polyethylene foam; oversized 50 percent to joint width; self expanding; in maximum lengths available.
- C. Reinforcing Positioners: Provide wire positioners in bed joints to keep steel reinforcing bars centered in cells, fabricated of 0.1483-inch hot-dip galvanized steel wire.
 - 1. Available Products:
 - a. Heckmann Building Products, Inc.; No. 376 Rebar Positioner.

- b. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
- c. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.
- D. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.05 LINTELS

- A. Masonry Lintels: Fabricated of bond beam CMUs, with texture matching adjacent standard CMU. Provide reinforcing bars and grout in accordance with structural requirements. Provide temporary supports until cured.
- B. Precast Concrete Lintels: Comply with structural requirements for concrete strength and reinforcing. Precast U-lintels fabricated in accordance with performance standards of PCI MNL-116 with 3500 psi concrete for standard lintels and 6000 psi concrete for prestressed lintels as manufactured by Cast-Crete are acceptable in lieu of rectangular section lintels.
- C. Steel Lintels: Refer to Section 055000 - Metal Fabrications.

2.06 MORTAR AND GROUT MIXING

- A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
 - 1. Masonry below grade and in contact with earth: Type S.
 - 2. Reinforced masonry: Type S.
 - 3. Exterior, loadbearing and non-loadbearing, and interior, loadbearing and non-loadbearing: Type N, except as indicated above.
 - a. Interior, non-loadbearing masonry may use Type O at Contractor's option.
- B. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.
- C. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.
- D. Mixing: Use mechanical batch mixer and comply with referenced standards.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.02 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.03 COLD AND HOT WEATHER REQUIREMENTS

- A. For installation in cold or hot weather, comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

3.04 GENERAL INSTALLATION REQUIREMENTS

- A. Establish lines, levels, and coursing indicated. Protect from displacement.

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- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
 - 1. CMU Coursing: One unit and one mortar joint equal 8 inches.
- C. Provide running bond for all masonry units unless otherwise indicated.
- D. Tool all mortar joints slightly concave where they will be exposed, unless otherwise indicated.
 - 1. Provide flush joints where they will be concealed by surface-applied treatments or finishes other than paint; including but not limited to tile, wall coverings, fluid-applied or SPF air barriers, or membranes.

3.05 PLACING AND BONDING

- A. Remove broken, cracked, chipped, or otherwise damaged masonry units from pallets and set aside. Do not use unless they may be field cut to remove damaged section, for installation where special shape is required to fit construction.
- B. Create a consistent blend for each type of veneer masonry by mixing units from a minimum of three pallets.
- C. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- D. Lay hollow masonry units with face shell bedding on head and bed joints.
- E. Remove excess mortar and mortar smears as work progresses.
- F. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- G. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
 - 1. Do not cut masonry unless it is required for certain shapes, such as rowlock sills, or unless it is unavoidable due to fitting around other construction, such as wall penetrations.
 - 2. Cut masonry edges shall not be visible in the final work. Where special shapes are required that would expose cut edges, they shall be plant-fabricated.

3.06 REINFORCEMENT AND ANCHORAGE - GENERAL AND SINGLE WYTHE MASONRY

- A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. At parapets and below-grade/foundations, provide joint reinforcement at 8 inches o.c. vertically.
- E. Embed longitudinal wires of joint reinforcement in mortar joint with at least 5/8 inch mortar cover on each side.
- F. Lap joint reinforcement ends minimum 6 inches.
- G. Do not extend reinforcement across control, expansion, and other building movement joints.
- H. Reinforce corners and intersections with prefabricated T- or L-shaped reinforcing.
- I. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 36 inches horizontally and 24 inches vertically.

- J. Embed ties and anchors in mortar joint and extend at least halfway through masonry veneer unit; with at least 5/8 inch mortar cover to the outside face of the anchor.

3.07 REINFORCEMENT AND ANCHORAGES - COMPOSITE UNIT MASONRY

- A. Install continuous horizontal joint reinforcement at 16 inches o.c. vertically, except at below grade foundation walls install at 8 inches o.c. vertically.
- B. Where concrete foundations are indicated, tie below-grade masonry to concrete with rigid anchors spaced at maximum 8 inches o.c. vertically.
- C. Coordinate with parging/dampproofing and with installation of insulation, where indicated.

3.08 LINTELS

- A. Comply with requirements on Structural Drawings for type of lintel at each opening, additional lintel sizing, reinforcement, and installation requirements.
- B. Install loose steel or precast lintels over openings, where indicated.
- C. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled.
 - 1. Allow masonry lintels to attain specified strength before removing temporary supports.
- D. Maintain minimum 8 inch bearing on each side of opening, unless otherwise indicated.

3.09 GROUTED COMPONENTS

- A. Comply with requirements on Structural Drawings for locations of structural grouted components and accessories, including but not limited to, grouted bond beams, reinforced unit masonry walls, (including locations and sizing of vertical steel bar reinforcing), grouted solid CMU, and composite wall collar joints.
- B. Lap splices minimum 24 bar diameters.
- C. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
- D. Place and consolidate grout fill without displacing reinforcing.

3.10 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control or expansion joints.
- B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
- C. Provide control and expansion joints at locations indicated on Drawings, and as follows:
 - 1. At changes in wall height.
 - 2. At changes in wall thickness
 - 3. At change in support (eg: transition from foundation support to floor slab support).
 - 4. Adjacent to corners of walls within a distance equal to no more than half the maximum control joint spacing.
 - 5. Wall intersections.
 - 6. Do not place control joints closer than 16 inches to edge of wall openings (doors, windows, louvers, ducts).
 - 7. Distance between joints shall not exceed a length to height ratio of 1.5:1.
 - 8. Distance between joints shall not exceed 25 feet where no openings occur between joints.
 - 9. Distance between joints shall not exceed 20 feet where openings occur between joints.

3.11 BUILT-IN WORK

- A. As work progresses, install built-in metal door frames, anchor bolts, and plates and other items to be built into the work and furnished under other sections.
- B. Install built-in items plumb, level, and true to line.
- C. Bed anchors of metal door frames in adjacent mortar joints. Fill frame voids solid with grout.
 - 1. Mix mortar (or grout) to a 4-inch maximum slump consistency and hand trowel into place in accordance with Steel Door Institute (SDI-100).
 - 2. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.
- D. Do not build into masonry construction organic materials that are subject to deterioration.

3.12 TOLERANCES

- A. Install masonry within the site tolerances found in TMS 402/602.
- B. Maximum Variation from Unit to Adjacent Unit: 1/16 inch.
- C. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
- D. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
- E. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
- F. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch.
- G. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

3.13 CUTTING AND FITTING

- A. Cut and fit for chases, pipes, conduit, and other penetrations. Coordinate with other sections of work to provide correct size, shape, and location.
- B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.14 FIELD QUALITY CONTROL

- A. Field Inspection: The Owner shall engage an independent inspection agency to perform field quality control inspections and prepare field reports.
 - 1. The Contractor shall permit full access to inspectors in order to perform inspections, including use of temporary facilities and equipment such as scaffolding or lifts.
 - 2. Do not enclose cavities or spaces to be grouted solid until inspections have approved grout and reinforcement for material properties, size, and installation locations.
- B. Field Testing: The Owner shall engage an independent testing agency to perform field quality control tests, as specified in Section 014000 - Quality Requirements. For each type of masonry unit, 5 randomly chosen units shall be sampled for each 5,000 square feet of wall.
 - 1. Concrete Masonry Unit Tests: Testing agency shall test each variety of concrete unit masonry, of each load-bearing size indicated, in accordance with ASTM C140/C140M requirements.
 - 2. Mortar Tests: Testing agency shall test each type of mortar in accordance with ASTM C780. Mortar shall be tested on each of the first 3 days. Alert testing agency if mortar mix is altered during construction to allow for retesting.
 - 3. Grout Test: Testing agency shall test each type of grout in accordance with ASTM C1019. Grout shall be tested on each of the first 3 days. Alert testing agency if grout mix is altered during construction to allow for retesting.

3.15 REPAIR AND CLEANING

- A. Remove masonry units that have become damaged or stained, or that do not display acceptable blend of color and texture matching mockup/sample panel. Remove as whole units, do not cut. Replace with new units with fresh mortar joints.
- B. Remove excess mortar and mortar droppings.
- C. Replace defective mortar and repoint. Enlarge holes or voids at defective mortar, and remove enough adjacent mortar to allow for repointing. Install fresh mortar joint and match to adjacent work.
- D. Where expansion/control joints and sealant joints are indicated, clean joints and leave them clear and ready for installation of joint or sealant materials.
- E. Clean concrete masonry in accordance with NCMA TEK 08-04A aBIA Technical Notes No. 20. Use hand cleaning/bucket-and-brush methods.
- F. To prevent freezing of cleaners and rinse water, do not clean when masonry surface temperature will drop below 40 degrees F.
- G. Test cleaning methods and materials on one half of mockup/sample panel; leave the other half uncleaned. Obtain approval of Architect before cleaning the finished work.
- H. Protect adjacent non-masonry surfaces from cleaning materials and processes with temporary sheeting or masking.
- I. Provide "in-progress" cleaning; clean masonry in each area as soon as possible after mortar has fully cured (approximately 7 to 28 days; coordinate with manufacturer's recommendations for each mortar type specified). Field test a small area to ensure mortar curing is complete prior to large-scale cleaning.
- J. Pre-wet masonry surfaces and clean with specified cleaning solution. Rinse surfaces immediately after cleaning; do not allow cleaning solution to dry or set into the masonry.
- K. Use non-metallic tools in cleaning operations.

3.16 MASONRY WASTE

- A. Remove all masonry waste from the site and properly dispose of or recycle in accordance with Division 1 waste disposal requirements.

END OF SECTION 042000

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Structural steel.
 - 2. Grout.
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications" miscellaneous steel fabrications and other steel items not defined as structural steel.

1.3 DEFINITIONS

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

1.4 COORDINATION

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

1.5 PREINSTALLATION MEETINGS

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

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show fabrication of structural-steel components.
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 2. Include embedment Drawings.
 - 3. 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 and connections of the Lateral-Force-Resisting System.

- C. Delegated-Design Submittal: For structural-steel connections indicated to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and fabricator.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Mill test reports for structural steel, including chemical and physical properties.
- E. Product Test Reports: For the following:
 - 1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 - 2. Direct-tension indicators.
 - 3. Tension-control, high-strength, bolt-nut-washer assemblies.
 - 4. Shop primers.
 - 5. Non-shrink grout.
- F. Source quality-control reports.
- G. Field quality-control and special inspection reports.

1.8 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD, or is accredited by the IAS Fabricator Inspection Program for Structural Steel (AC 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 according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Comply with applicable provisions of the following specifications and documents:
 - 1. AISC 303.
 - 2. AISC 360.
 - 3. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering analysis by a qualified professional engineer, to withstand loads indicated and comply with other information and restrictions indicated.
 1. Select and complete connections using schematic details indicated and AISC 360.
 2. Use Allowable Stress Design; data are given at service-load level.
- B. Moment Connections: Type FR, fully restrained.
- C. Construction: Moment frame.
- D. Recycled Content: Provide products with a minimum post-consumer recycled content of 75%.

2.2 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: As indicated.
- B. Channels, Angles-Shapes: As indicated.
- C. Plate and Bar: As indicated.
- D. Cold-Formed Hollow Structural Sections: As indicated.
- E. Steel Pipe: As indicated.
 1. Weight Class: as indicated.
- F. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM F 3125 Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.
 1. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with plain finish.
- B. High-Strength Bolts, Nuts, and Washers: ASTM F 3125 Grade A490, Type 1, heavy-hex steel structural bolts or tension-control, bolt-nut-washer assemblies with splined ends; ASTM A 563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers with plain finish.
 1. Direct-Tension Indicators: ASTM F 959, Type 490, compressible-washer type with plain finish.

- C. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers.
 - 1. Finish: Hot-dip zinc coating.
 - 2. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with mechanically deposited zinc coating finish.
 - D. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 3125 Grade F1852 or Grade F2280, Type 1, round head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
 - 1. Finish: Plain.
 - E. Unheaded Anchor Rods: ASTM F 1554, Grade 36
 - 1. Configuration: Straight.
 - 2. Nuts: ASTM A 563 heavy-hex carbon steel.
 - 3. Plate Washers: ASTM A 36/A 36M carbon steel.
 - 4. Washers: ASTM F 436, Type 1, hardened carbon steel.
 - 5. Finish: Plain.
 - F. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.
 - 1. Nuts: ASTM A 563 heavy-hex carbon steel.
 - 2. Plate Washers: ASTM A 36/A 36M carbon steel.
 - 3. Washers: ASTM F 436, Type 1, hardened carbon steel.
 - 4. Finish: Plain.
 - G. Threaded Rods: ASTM A 36/A 36M.
 - 1. Nuts: ASTM A 563 heavy-hex carbon steel.
 - 2. Washers: ASTM F 436, Type 1, hardened carbon steel.
 - 3. Finish: Plain.
 - H. Clevises: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.
 - I. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.
 - J. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.
- 2.4 PRIMER
- A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 - B. Primer: Comply with Division 9.
 - C. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
 - D. Galvanizing Repair Paint: ASTM A 780/A 780M.

2.5 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.6 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.
 - 1. Camber structural-steel members where indicated.
 - 2. Fabricate beams with rolling camber up.
 - 3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel 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 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 according to SSPC-SP 2, "Hand Tool Cleaning."
- F. Headed Rods: Prepare steel surfaces as recommended by manufacturer of headed rods. Use automatic end welding of headed-stud rods according to 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.

2.7 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: as indicated.
- 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 AISC 303 for mill material.

2.8 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. Galvanized surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 - 1. For Concealed Steel:
 - a. SSPC-SP 2, "Hand Tool Cleaning."
 - b. SSPC-SP 3, "Power Tool Cleaning."
 - 2. For Exposed Steel:
 - a. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 - 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.
- D. Painting: Prepare steel and apply a one-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils (0.038 mm).

2.9 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.
 - 1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
 - 2. Galvanize lintels and shelf angles attached to structural-steel frame and located in exterior walls.

2.10 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
 - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Bolted Connections: Inspect and test shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E 165.
 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 3. Ultrasonic Inspection: ASTM E 164.
 4. Radiographic Inspection: ASTM E 94.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
- 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.
 1. Do not remove temporary shoring supporting composite deck construction 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 according to AISC 303 and AISC 360.
- B. Baseplates and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 2. Weld plate washers to top of baseplate where indicated.
 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 1. Level and plumb individual members of structure.

2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection.
- 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 according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 1. Joint Type: Snug tightened, unless noted otherwise.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
 3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 1. Verify structural-steel materials and inspect steel frame joint details.
 2. Verify weld materials and inspect welds.
 3. Verify connection materials and inspect high-strength bolted connections.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- C. Bolted Connections: Inspect and test bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.
 1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.

3.6 REPAIRS AND PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780/A 780M.
- B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
- C. Touchup Painting: Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- D. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

END OF SECTION 051200

SECTION 052100 - STEEL JOIST FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. K-series steel joists.
 - 2. KCS-type K-series steel joists.
 - 3. K-series steel joist substitutes.
 - 4. Joist accessories.

1.3 DEFINITIONS

- A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."
- B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support non-uniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of joist, accessory, and product.
- B. Shop Drawings:
 - 1. Include layout, designation, number, type, location, and spacing of joists.
 - 2. Include joining and anchorage details, bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
 - 3. Indicate locations and details of bearing plates to be embedded in other construction.
- C. Delegated-Design Submittal: For special joists and connections indicated to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Welding certificates.
- C. Manufacturer certificates.
- D. Mill Certificates: For each type of bolt.
- E. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications."
 - 1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.
- B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Recycled Content: Provide products with a minimum post-consumer recycled content of 60%.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle joists as recommended in SJI's "Specifications."
- B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.
 - 1. Use ASD; data are given at service-load level.
 - 2. Design special joists to withstand design loads with live-load deflections no greater than the following:
 - a. Roof Joists: Vertical deflection of 1/360 of the span.

2.2 K-SERIES STEEL JOISTS

- A. Manufacture steel joists of type indicated according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
 - 1. Joist Type: K-series steel joists and KCS-type K-series steel joists.
- B. Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.
- C. Provide holes in chord members for connecting and securing other construction to joists.
- D. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated, complying with SJI's "Specifications."
- E. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated, complying with SJI's "Specifications."
- F. Do not camber joists.
- G. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.3 PRIMERS

- A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.
- C. Primer: Provide shop primer that complies with Division 9.

2.4 JOIST ACCESSORIES

- A. Bridging: Provide bridging anchors and number of rows of bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.
- B. Bridging: Schematically indicated. Detail and fabricate according to SJI's "Specifications." Furnish additional erection bridging if required for stability.
- C. Steel bearing plates with integral anchorages are specified in Section 055000 "Metal Fabrications."
- D. Welding Electrodes: Comply with AWS standards.

- E. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.5 CLEANING AND SHOP PAINTING

- A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.
- B. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Do not install joists until supporting construction is in place and secured.
- B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written recommendations, and requirements in this Section.
 - 1. Before installation, splice joists delivered to Project site in more than one piece.
 - 2. Space, adjust, and align joists accurately in location before permanently fastening.
 - 3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
 - 4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads are applied.
- C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
- D. Bolt joists to supporting steel framework using carbon-steel bolts.
- E. Bolt joists to supporting steel framework using high-strength structural bolts. Comply with Research Council on Structural Connection's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts" for high-strength structural bolt installation and tightening requirements.

- F. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and bolted connections and to perform field tests and inspections and prepare test and inspection reports.
- B. Visually inspect field welds according to AWS D1.1/D1.1M.
 - 1. In addition to visual inspection, test field welds according to AWS D1.1/D1.1M and the following procedures, as applicable:
- C. Visually inspect bolted connections.
- D. Correct deficiencies in Work that test and inspection reports have indicated are not in compliance with specified requirements.
- E. Perform additional testing to determine compliance of corrected Work with specified requirements.

3.4 PROTECTION

- A. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and abutting structural steel and accessories.
 - 1. Clean and prepare surfaces by hand-tool cleaning according to SSPC-SP 2, or power-tool cleaning according to SSPC-SP 3.
 - 2. Apply a compatible primer of same type as primer used on adjacent surfaces.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that joists and accessories are without damage or deterioration at time of Substantial Completion.

END OF SECTION 052100

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Roof deck.
 - 2. Non-composite form deck.
 - 3. Accessories

- B. Related Requirements:

- 1. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.
 - 2. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.

- B. Shop Drawings:

- 1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

- B. Product Certificates: For each type of steel deck.

- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

- 1. Power-actuated mechanical fasteners.

- D. Evaluation Reports: For steel deck.

- E. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."
- C. FM Global Listing: Provide steel roof deck evaluated by FM Global and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.
- D. Recycled Content: Provide products with a minimum post-consumer recycled content of 75%.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
- B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
- C. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 ROOF DECK

- A. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:

1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 40, G60 zinc coating.
2. Galvanized and Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 40, G60 zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.
3. Deck Profile: As indicated.
4. Cellular Deck Profile: Long span, with bottom plate.
5. Profile Depth: As indicated.
6. Design Uncoated-Steel Thickness: As indicated.
7. Design Uncoated-Steel Thicknesses; Deck Unit/Bottom Plate: As indicated.
8. Span Condition: Triple span or more.
9. Side Laps: Overlapped or interlocking seam at Contractor's option.

2.3 NON-COMPOSITE FORM DECK

- A. Non-Composite Form Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Non-Composite Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
 1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 50, G60 zinc coating.
 2. Galvanized and Shop-Primed Steel Sheet: ASTM A 653/A 653 M, Structural Steel (SS), Grade 50, G60 Zinc coating; with unpainted top surface and cleaned and pretreated bottom surface primed with manufacturer's standard baked-On, rust-inhibitive primer.
 3. Profile Depth: As indicated.
 4. Design Uncoated-Steel Thickness: As indicated.
 5. Span Condition: Triple span or more.

2.4 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 40,000 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. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.

- G. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch wide flanges and recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.
- H. Galvanizing Repair Paint: ASTM A 780.
- I. 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.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
 - 1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

3.3 ROOF-DECK INSTALLATION

- A. Fasten roof-deck panels to steel supporting members as indicated.

- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports as indicated
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 - 1. End Joints: Lapped 2 inches minimum.
- D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld flanges to top of deck. Space welds not more than 12 inches apart with at least one weld at each corner.
- E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.
 - 1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.
- F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 FLOOR-DECK INSTALLATION

- A. Fasten floor-deck panels to steel supporting members as indicated.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports as indicated.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 - 1. End Joints: Lapped 2 inches minimum.
- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.
- E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of decks, unless otherwise indicated.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Field welds will be subject to inspection.
- C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.

- D. Remove and replace work that does not comply with specified requirements.
- E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.6 PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
 - 1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
- C. Repair Painting: Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in division 9.
- D. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 053100

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Exterior non-load-bearing wall framing.
 - 2. Interior non-load-bearing wall framing indicated as CFSF-S.
 - 3. Ceiling joist framing.
 - 4. Soffit framing.

- B. Related Requirements:

- 1. Section 055000 "Metal Fabrications" for miscellaneous steel shapes, masonry shelf angles, and connections used with cold-formed metal framing.
 - 2. Section 092216 "Cold Formed Steel Framing – Non-Structural (CFSF-NS)" for standard, interior non-load-bearing, metal-stud framing, with height limitations and ceiling-suspension assemblies.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of cold-formed steel framing product and accessory.

- B. Shop Drawings:

- 1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
 - 2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

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

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Welding certificates.
- C. Product Certificates: For each type of code-compliance certification for studs and tracks.
- D. Product Test Reports: For each listed product, for tests performed by manufacturer and witnessed by a qualified testing agency.
 - 1. Steel sheet.
 - 2. Post-installed anchors.
 - 3. Power-actuated anchors.
 - 4. Mechanical fasteners.
 - 5. Vertical deflection clips.
 - 6. Horizontal drift deflection clips
 - 7. Miscellaneous structural clips and accessories.
- E. Research Reports:
 - 1. For nonstandard cold-formed steel framing, post-installed anchors, and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.
- B. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- C. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association, the Steel Framing Industry Association or the Steel Stud Manufacturers Association.
- D. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
- E. Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing – General Provisions."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

1. AllSteel Products, Inc.
2. Clark Steel Framing.
3. Consolidated Fabricators Corp.; Building Products Division.
4. Craco Metals Manufacturing, LLC.
5. Custom Stud, Inc.
6. Formetal Co, (The).
7. MarinoWare; a division of Ware Industries.
8. SCAFCO Corporation.
9. Southeastern Stud & Components, Inc.
10. Steel Construction Systems.
11. United Metal Products, Inc.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.
- B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
 1. Design Loads: As indicated on Drawings.
 2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/360 of the wall height. Maximum horizontal deflection of 1/600 of the wall height where supporting brick veneer, GFRC, or architectural precast concrete.
 - b. Interior Non-Load-Bearing Framing indicated as CFSF-S: Horizontal deflection of 1/360 of the wall height under a horizontal load of 5 lbf/sq. ft.
 - c. Ceiling Joist Framing: Vertical deflection of 1/360 of the span for live loads and 1/240 for total loads of the span.
 3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
 4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
 - a. Upward and downward movement of 1-1/2 inches.
 5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

- C. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100, AISI S200, and the following:
 - 1. Wall Studs: AISI S211.
 - 2. Headers: AISI S212.
 - 3. Lateral Design: AISI S213.
- D. 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 the listings of another qualified testing agency acceptable to authorities having jurisdiction.

2.3 COLD-FORMED STEEL FRAMING MATERIALS

- A. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:
 - 1. Grade: As required by structural performance.
 - 2. Coating: G60.
- B. Steel Sheet for Vertical Deflection and Drift Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:
 - 1. Grade: As required by structural performance.
 - 2. Coating: G60.

2.4 EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0428 inch.
 - 2. Flange Width: 1-5/8 inches.
 - 3. Depth: As indicated.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0428 inch.
 - 2. Flange Width: 1-1/4 inches.
- C. Vertical Deflection Clips: Manufacturer's standard bypass clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with

flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch.
 2. Flange Width: 1 inch plus the design gap for one-story structures and 1 inch plus twice the design gap for other applications.
- E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
 - a. Minimum Base-Metal Thickness: 0.0428 inch.
 - b. Flange Width: 1 inch plus the design gap for one-story structures and 1 inch plus twice the design gap for other applications.
 2. Inner Track: Of web depth indicated, and as follows:
 - a. Minimum Base-Metal Thickness: 0.0428 inch.
 - b. Flange Width: Outer deflection track flange width plus 1 inch.
- F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.5 INTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0428 inch.
 2. Flange Width: 1-5/8 inches.
 3. Depth: As indicated.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0428 inch.
 2. Flange Width: 1-1/4 inches.
- C. Vertical Deflection Clips: Manufacturer's standard bypass clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with

flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch.
 2. Flange Width: 1 inch plus the design gap for one-story structures and 1 inch plus twice the design gap for other applications.
- E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
 - a. Minimum Base-Metal Thickness: 0.0428 inch.
 - b. Flange Width: 1 inch plus the design gap for one-story structures and 1 inch plus twice the design gap for other applications.
 2. Inner Track: Of web depth indicated, and as follows:
 - a. Minimum Base-Metal Thickness: 0.0428 inch.
 - b. Flange Width: Outer deflection track flange width plus 1 inch.
- F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.6 CEILING JOIST FRAMING

- A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, unpunched, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0428 inch.
 2. Flange Width: 1-5/8 inches, minimum.

2.7 SOFFIT FRAMING

- A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0428 inch.
 2. Flange Width: 1-5/8 inches, minimum.

2.8 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, as follows:
1. Supplementary framing.
 2. Bracing, bridging, and solid blocking.
 3. Web stiffeners.
 4. Anchor clips.
 5. End clips.
 6. Foundation clips.
 7. Gusset plates.
 8. Stud kickers and knee braces.
 9. Joist hangers and end closures.
 10. Hole-reinforcing plates.
 11. Backer plates.

2.9 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.
- B. Anchor Bolts: ASTM F1554, Grade 55 weldable (supplement S1), threaded carbon-steel hex-headed bolts, carbon-steel nuts, and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A153/A153M, Class C.
- C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC58 or ICC-ES AC308 as appropriate for the substrate.
1. Uses: Securing cold-formed steel framing to structure.
 2. Type: Torque-controlled adhesive anchor or adhesive anchor.
 3. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
 4. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F593, and nuts, ASTM F594.
- D. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- E. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.
- F. Welding Electrodes: Comply with AWS standards.

2.10 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: ASTM A780.
- B. Cement Grout: Portland cement, ASTM C150/C150M, Type I; and clean, natural sand, ASTM C404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C1107/C1107M, and with a fluid consistency and 30-minute working time.
- D. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.
- E. Sill Sealer Gasket: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.
- F. Sill Sealer Gasket/Termite Barrier: Minimum 68-mil nominal thickness, self-adhering sheet consisting of 64 mils of rubberized asphalt laminated on one side to a 4-mil- thick, polyethylene-film reinforcement, and with release liner on adhesive side; formulated for application with primer or surface conditioner that complies with VOC limits of authorities having jurisdiction.
 - 1. Physical Properties:
 - a. Peel Adhesion: 17.0 lb/in of width when tested in accordance with ASTM D412.
 - b. Low-Temperature Flexibility: Pass at minus 25 deg F ASTM D146/D146M.
 - c. Water Vapor Permeance: 0.05 perm maximum when tested in accordance with ASTM E96/E96M, Method B.
 - d. Resistance to Termite Penetration: Comply with ICC-ES AC380.

2.11 FABRICATION

- A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
 - 1. Fabricate framing assemblies using jigs or templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.
 - 3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.

- 4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.
- C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet and as follows:
 - 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 - 2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine 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 PREPARATION

- A. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete or masonry construction.
- B. Install sill sealer gasket at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.
- C. Install sill sealer gasket/termite barrier in accordance with manufacturer's written instructions at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 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.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.
 - D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
 1. Cut framing members by sawing or shearing; do not torch cut.
 2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.
 - E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
 - F. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
 - G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
 - H. Install insulation, specified in Division 7 in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
 - I. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.
- 3.4 INSTALLATION OF EXTERIOR 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. Do not fasten studs to deflection track. Space studs as follows:
 1. Stud Spacing: As indicated on Drawings.
 - C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
 - D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Connect vertical deflection clips to bypassing studs and anchor to building structure.
 2. Connect drift clips to cold-formed steel framing and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
 2. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
1. Install solid blocking at centers indicated on Shop Drawings.
- G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 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. Do not fasten studs to deflection track. Space studs as follows:
1. Stud Spacing: As indicated on Drawings.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
1. Install single deep-leg deflection tracks and anchor to building structure.
 2. Connect vertical deflection clips to studs and anchor to building structure.
 3. Connect drift clips to cold-formed steel metal framing and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
 2. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

- F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
 - 1. Install solid blocking at centers indicated on Shop Drawings.
- G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.6 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 indicated on Drawings.
- D. Frame openings with built-up joist headers, consisting of joist and joist track or another combination of connected joists if indicated.
- E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement.
 - 1. Install web stiffeners to transfer axial loads of walls above.
- F. Install bridging at intervals indicated on Shop Drawings. Fasten bridging at each joist intersection as follows:
 - 1. Joist-Track Solid Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
 - 2. Combination Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.
- 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.

3.7 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 shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.8 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.

3.9 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.

3.10 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

1.01 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
- B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- D. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
- E. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
- F. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- G. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
- I. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification.
- J. AWS D1.1/D1.1M - Structural Welding Code - Steel.
- K. AWS D1.2/D1.2M - Structural Welding Code - Aluminum.
- L. NAAMM MBG 531 - Metal Bar Grating Manual.
- M. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer.
- N. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic).

1.02 SUBMITTALS

- A. Product Data: Provide product data for factory fabricated products and accessory materials, including the following:
 - 1. Nonshrink grout.
 - 2. Shop primer paint products.
 - a. Coordinate with Division 9 Painting topcoat manufacturer and provide compatibility certificates from topcoat manufacturer that shop primers are acceptable substrate for specified topcoats.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
 - 1. Include field measurements, and indicate where field measurements differ from documents.
 - 2. Design data: Submit drawings and supporting calculations, signed and sealed by a qualified professional structural engineer.

- C. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

1.03 QUALITY ASSURANCE

- A. Design mechanical supports and miscellaneous steel shapes under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
- B. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.2/D1.2M and dated no more than 12 months before start of scheduled welding work.
- C. Field Measurements: Take field measurements prior to fabrication and verify that dimensions and tolerances are acceptable for fabricated products to fit the space. Indicate field measurements on shop drawings.

PART 2 PRODUCTS

2.01 GENERAL

- A. Materials, General: Provide metal fabrications and components with finished surfaces that are smooth and flat. Metal fabrications and components shall not have labels, stickers, engraved or rolled manufacturer names, seams, or blemishes that are exposed in the finished work.

2.02 MATERIALS - STEEL

- A. Steel Sections: ASTM A36/A36M.
- B. Steel Tubing: ASTM A500/A500M Grade B cold-formed structural tubing.
- C. Plates: ASTM A283/A283M.
- D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
- E. Slotted Channel Fittings: ASTM A1011/A1011M.
- F. Mechanical Fasteners: Same material as or compatible with materials being fastened; type consistent with design and specified quality level.
 - 1. Provide stainless steel fasteners for all exterior construction and for fastening aluminum and stainless steel fabrications.
 - 2. Provide stainless steel fasteners at areas subject to moisture or steam, including mechanical rooms, janitor/custodial rooms with floor sinks, and similar spaces.
 - 3. Provide zinc-plated fasteners for interior construction except where stainless steel is indicated.
- G. Bolts, Nuts, and Washers: ASTM A307, Grade A, galvanized to ASTM A153/A153M where connecting galvanized components.
- H. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- I. Shop and Touch-Up Primer: SSPC-Paint 15, universal shop primer, complying with VOC limitations of authorities having jurisdiction.
- J. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.03 FABRICATION

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.

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- C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- D. Furnish components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.04 FABRICATED ITEMS

- A. Metal Ladders: Refer to Division 5 Section "Metal Ladders".
- B. Bollards: Schedule 40 steel pipe, concrete filled, crowned cap, as detailed; nominal 6-inch diameter unless otherwise indicated; prime paint finish.
 - 1. In lieu of field formed crowned cap, Contractor may at its option provide precast, symmetrically domed caps.
- C. Channels and Plates Not Attached to Structural Framing: For support of metal decking and masonry; prime paint finish.
- D. Lintels: As detailed; prime paint finish.
- E. Slotted Channel Framing: Fabricate channels and fittings from ASTM A1011/A1011M, Grade 33 structural steel complying with the referenced standards; with factory-applied, rust-inhibiting thermoset acrylic enamel finish.
 - 1. Provide 1-5/8 inch by 1-5/8 inch channel unless otherwise indicated.
- F. Miscellaneous Steel Shapes: Provide steel shapes for miscellaneous applications indicated on drawings, including but not limited to, reinforcing steel shapes at low partitions/knee walls and concrete slab edge angles.

2.05 FINISHES - STEEL

- A. Prime paint steel items.
 - 1. Exceptions: Galvanize and do not prime items to be embedded in concrete and items to be embedded in masonry. Do not prime items to be embedded in sprayed fireproofing.
- B. Prepare interior items to be primed in accordance with SSPC-SP3 Power Tool Cleaning.
- C. Prepare exterior items to be primed, and interior items to receive specialty protective coating such as zinc-rich primer, in accordance with SSPC-SP 6/NACE No. 3 Commercial Blast Cleaning.
- D. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- E. Prime Painting: One coat.
- F. Galvanizing: Galvanize after fabrication to ASTM A123/A123M requirements.
- G. Slotted Channel Framing: ASTM A1011/A1011M Grade 33; coated with manufacturer's standard rust-inhibitive acrylic enamel.

2.06 FABRICATION TOLERANCES

- A. Squareness: 1/8 inch maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch.
- C. Maximum Misalignment of Adjacent Members: 1/16 inch.
- D. Maximum Bow: 1/8 inch in 48 inches.
- E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Furnish setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Perform field welding in accordance with AWS D1.1/D1.1M.
- D. Obtain approval prior to site cutting or making adjustments not scheduled.
- E. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.
- F. Installation of Bollards: Anchor bollards in concrete footings to a minimum depth of 36 inches with 6 inches of concrete below bottom of bollards. Fill bollards with concrete.
 - 1. At Contractor's option, provide either precast caps secured to wet concrete fill, or field-mound wet concrete fill to form a rounded cap.

3.04 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION 055000

**SECTION 061000
ROUGH CARPENTRY**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing.
- B. ASTM D3498 - Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- D. AWWA U1 - Use Category System: User Specification for Treated Wood.
- E. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.
- F. EPA (TSCA); Title VI - Toxic Substances Control Act, Title VI: Formaldehyde Standards for Composite Wood Products.
- G. PS 1 - Structural Plywood.
- H. PS 20 - American Softwood Lumber Standard.
- I. SCAQMD 1168 - Adhesive and Sealant Applications.

1.02 SUBMITTALS

- A. Product Data: Provide technical data for fire-retardant materials, wood preservative materials, and include certification that materials and treatment comply with manufacturer's requirements.
 - 1. Evaluation Reports: Provide ICC-ES evaluation reports for each applicable item below:
 - a. Preservative-treated lumber.
 - b. Fire-retardant-treated lumber.
 - c. Each type of power- or powder-actuated fastener and expansion anchor.
 - d. Structural wood connectors (framing anchors).

1.03 QUALITY ASSURANCE

- A. Testing Agency Qualifications (for Fire-Retardant Treatments): Independent firm specializing in performing testing of treatments of type specified in this section, and performing periodic inspections to ensure that the material receiving the classification marking matches the tested material; and approved by local authority having jurisdiction.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
- B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.

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1. Grading Agencies: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org and who provides grading service for the species and grade specified.
 - a. Northeastern Lumber Manufacturer's Association (NELMA) - Spruce-Pine-Fir.
 - b. Southern Pine Inspection Bureau (SPIB) - Southern Pine.
 - c. West Coast Lumber Inspection Bureau (WCLIB) - Douglas Fir, Hem Fir, Spruce-Pine-Fir-South.
 - d. Western Wood Products Association (WWPA) - Douglas Fir, Hem Fir; Spruce-Pine-Fir-South.
 - e. National Lumber Grades Authority (NLGA) - Douglas Fir-North, Hem Fir-North, Spruce-Pine-Fir.
 2. Provide lumber stamped with grade mark of responsible grading agency, unless otherwise indicated.
 - a. Place grade stamp on unexposed surface of lumber specified to be exposed with natural or stained finish, or omit grade stamp and submit documentation from grading agency certifying grade compliance.
 3. Species and Grade:
 - a. Species and grade is indicated on Structural Drawings for studs, joists, rafters, beams, columns, ceiling joists, and other structural components, as applicable.
 - b. For miscellaneous lumber including non-structural miscellaneous framing, blocking, nailers, grounds, and furring, provide No. 2 or Standard grade.
 - c. Lumber of other species or grades is acceptable provided structural and appearance characteristics are equivalent to or better than products specified.
 4. Moisture Content: S-dry or MC19 (19% or less). Applies to lumber for 2-inch nominal thickness and less.
- B. Composite Wood: Any composite wood materials installed inside the weatherproofing system shall meet either EPA (TSCA); Title VI for ultra-low-emitting formaldehyde or no added formaldehyde (ULEF / NAUF).

2.02 WOOD CONSTRUCTION PANELS

- A. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 25 or less, when tested in accordance with ASTM E84 (Class A - UL FR-S).

2.03 ACCESSORIES

- A. Fasteners and Anchors:
1. Metal and Finish: Provide hot-dipped galvanized steel complying with ASTM A 153 or stainless steel at exterior, high humidity, and preservative-treated wood locations.
 - a. Fasteners at interior FRT shall be per FRT treatment manufacturer's recommendations.
 2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
 3. Anchors: Toggle bolt type for anchorage to hollow masonry.
- B. Flexible Flashing/Separation Material: Barrier sheet fabricated of polyethylene backed rubberized asphalt or butyl rubber sheet; not less than 25 mil overall thickness.
- C. General Purpose Construction Adhesives: Comply with ASTM C557 or ASTM D3498.

1. Adhesives: Adhesives field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with CAL (CDPH SM) AND shall meet the chemical content requirements of SCAQMD 1168.

2.04 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWP A U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
 1. Fire-Retardant Treated Wood: Provide FRT lumber and plywood stamped with name and mark of qualified testing agency, fire-retardant treatment product and manufacturer, wood species and drying method, testing standards, and flame spread and smoke development indices.
 2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWP A standards.
- B. Fire Retardant Treatment:
 1. Interior Type A: AWP A U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 and maximum smoke developed index of 450, when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
 - a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
 - b. Treat interior concealed blocking, plywood backing panels, and other rough carpentry items as indicated.
 - c. Do not use treated wood in applications exposed to weather or where the wood may become wet.
 2. Strength Adjustments (Structural Panels/Plywood): Test FRT structural panels/plywood per ASTM D 5516 and develop strength adjustment factors per ASTM D 6305.
 3. Strength Adjustments (Lumber): Test FRT lumber per ASTM D 5664 and develop strength adjustment factors per ASTM D 6841.
- C. Preservative Treatment:
 1. Restrictions: Do not use lumber or plywood treated with chromated copper arsenate (CCA). Do not use lumber or plywood treated with inorganic boron (SBX) for applications exposed to water, ground/soil contact, or interior floor slabs/concrete. Comply with additional treatment restrictions as required by local authorities having jurisdiction.
 2. Preservative Pressure Treatment of Lumber & Plywood Above Grade: AWP A U1, Use Category UC3B, Commodity Specification A using waterborne preservative.
 - a. Use Category UC2 is acceptable for interior lumber and plywood above grade (not in contact with floor slab).
 - b. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
 - c. Treat lumber exposed to weather.
 - d. Treat lumber in contact with roofing, flashing, or waterproofing.
 - e. Treat lumber in contact with masonry or concrete.
 - f. Treat lumber less than 18 inches above grade, and lumber located directly against below-grade exterior walls.
 - g. Treat lumber in other locations as indicated.

3. Preservative Pressure Treatment of Lumber in Contact with Ground/Soil: AWPAC U1, Use Category UC4A, Commodity Specification A using waterborne preservative.
 - a. Preservative for Field Application to Cut Surfaces: As recommended by manufacturer of factory treatment chemicals for brush-application in the field.

PART 3 EXECUTION

3.01 PREPARATION

- A. Coordinate installation of rough carpentry members specified in other sections.

3.02 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.03 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In metal-framed walls, provide continuous FRT blocking around door and window openings for anchorage of frames, securely attached to stud framing.
- C. In metal-framed walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- D. Where PPT blocking is indicated to be installed directly adjacent to metal decking or other galvanized metals, provide flexible flashing/separation material as a continuous barrier to prevent direct contact between materials.

3.04 INSTALLATION OF CONSTRUCTION PANELS

- A. Communications and Electrical Room Mounting Boards: Secure with screws, to furring or to framing as applicable, with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and in field of board.
 1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
 2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
 3. Install adjacent boards without gaps.

3.05 CLEANING

- A. Waste Disposal: Refer to Section 017419 - Construction Waste Management and Disposal.
 1. Comply with applicable regulations.
 2. Do not burn scrap on project site.
 3. Do not burn scraps that have been pressure treated.
 4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or "waste-to-energy" facilities.
- B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.

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- C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION 061000

SECTION 064100
ARCHITECTURAL WOODWORK AND CASEWORK

PART 1 GENERAL

1.01 DEFINITIONS

- A. Exposed: Portions of casework visible when drawers and cabinet doors are closed, including end panels, bottoms of cases more than 42 inches above finished floor, tops of cases less than 72 inches above finished floor and all members visible in open cases or behind glass doors.
- B. Semi-Exposed: Portions of casework and surfaces behind solid doors, tops of cases more than 72 inches above finished floor and bottoms of cabinets more than 30 inches but less than 42 inches above finished floor.
- C. Concealed: Sleepers, web frames, dust panels and other surfaces not generally visible after installation and cabinets less than 30 inches above finished floor.

1.02 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. AWI (QCP) - Quality Certification Program.
- C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition.
- D. ISFA 2-01 - Classification and Standards for Solid Surfacing Material.
- E. NEMA LD 3 - High-Pressure Decorative Laminates.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting not less than one week before starting work of this section; require attendance by all affected installers.

1.04 SUBMITTALS

- A. Product Data: Component dimensions, configurations, construction details, joint details, attachments.
 - 1. Include product data for each type of hardware and accessory.
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 - 1. Include field measurements, and indicate where field measurements differ from documents.
- C. Selection Samples: Submit manufacturer's color charts indicating full range of available colors, for each product requiring color selection. Architect will request samples from chart.
- D. Fabricator Qualifications: Include evidence of accreditation with quality control program.
- E. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

1.05 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with experience on Projects of similar size and scope.
 - 1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.

B. Quality Certification:

1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.awiqcp.org/#sle.
2. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) requirements for grade or grades specified.
3. Provide designated labels on shop drawings as required by certification program.
4. Provide designated labels on installed products as required by certification program.
5. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.
6. Replace, repair, or rework all work for which certification is refused.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Section 2 of the Architectural Woodwork Standards: "Care & Storage."
- B. Deliver woodwork after finishes are complete, including painting, and HVAC is operating at occupancy conditions in all spaces where woodwork will be installed.
- C. Store in an environmentally controlled location. Protect units from moisture damage.

1.07 FIELD CONDITIONS

- A. During and after installation of woodwork, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS), unless noted otherwise.
- B. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84, unless otherwise indicated for specific products.
- C. Accessibility Requirements: Fabricate and install woodwork and casework in compliance with ICC/ANSI A117.1 and with ADA Standards for Accessible Design.

2.02 CABINETS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS), unless noted otherwise.
- B. Plastic-Laminate-Clad Cabinets: Custom grade, except as modified below. Solid wood and wood panel construction; each unit self-contained and not dependent on adjacent units or building structure for rigidity; in sizes necessary to avoid field cutting except for scribes and filler panels. Include adjustable levelers for base cabinets.
 1. Style: Reveal overlay. Ease doors and drawer fronts slightly at edges.
 2. Cabinet Nominal Dimensions: Unless otherwise indicated, provide cabinets of widths and heights indicated on drawings, and with following front-to-back dimensions:
 - a. Base Cabinets: 24 inches.
 - b. Wall Cabinets: 12-1/2 inches. (Minimum clear interior depth shall be 11 inches)
 3. Drawer Construction: Provide AWI premium grade for drawer box construction.
 4. Base Construction: Provide adjustable levelers for all base cabinets to facilitate load transfer to the floor, isolate cabinet ends from the floor, and permit leveling.

- a. Toe Kick: Toe kick shall be nominal 4 inch height. Reduce as necessary via field modification due to construction tolerances and concrete slab levelness to maintain maximum height dimensions indicated.
- 5. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline.
 - a. Exposed Interior and Semi-Exposed Surfaces: Provide HPDL, type VGS or CLS, at semi-exposed interiors of cabinets (cabinets with doors) and drawer boxes. Provide type VGS for exposed interior horizontal shelving surfaces and interiors of open cabinets (no doors).
- C. ADA Sink Cabinets: Provide casework manufacturer's standard hinged front door panels, with matching veneer/cladding material and toe kick built into door panels, to match appearance of adjacent base cabinets. Front door panels swing open to 160 degrees minimum to allow for ADA-compliant undercounter knee space and for plumbing access to sink.

2.03 WOOD-BASED COMPONENTS

2.04 LAMINATE MATERIALS

- A. Manufacturers:
 - 1. Formica Corporation; High Pressure Laminate.
 - 2. Panolam Industries International, Inc; Nevamar Standard HPL.
 - 3. Panolam Industries International, Inc; Pionite Standard HPL.
 - 4. Wilsonart LLC; High Pressure Laminate (HPL).
- B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.
- C. Color and Pattern: To be selected by Architect from Manufacturer's full range (standard and premium colors) in standard textured finish (textured gloss, fine textured, or suede finish). High gloss, heavy textured, metallic, or other special surface products (abrasion-resistant, chemical-resistant) will not be required for use in this project.
- D. Provide specific types as follows:
 - 1. Horizontal Countertop Surfaces: HGS, 0.048 inch (1.2 mm) nominal thickness.
 - 2. Vertical Surfaces and Non-Countertop Horizontal Surfaces: VGS, 0.028 inch (0.7 mm) nominal thickness.
 - 3. Cabinet Liner: CLS, 0.020 inch (0.5 mm) nominal thickness.
 - 4. Laminate Backer: BKL, 0.020 inch nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

2.05 SOLID SURFACING MATERIAL

- A. Solid Surfacing Material: ISFA 2-01.
 - 1. Products:
 - a. E. I. du Pont de Nemours and Company; Corian.
 - b. Formica Group; Solid Surfacing.
 - c. LG Hausys America; HI-MACS.
 - d. Meganite, Inc; Meganite Acrylic Solid Surface.
 - e. Wilsonart LLC; Solid Surface.
 - 2. Thickness: 1/2-inch.
 - 3. Type: Standard Type.
 - 4. Color and Pattern: To be selected by Architect from manufacturer's full range.

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5. Color and Pattern: Provide colors per the following:
 - a. Colors and Patterns for Countertops: As selected by Architect from manufacturer's full range of colors equivalent to Dupont Corian price group 4.

2.06 COUNTERTOPS

- A. Fabricate in accordance with AWI/AWMAC/WI (AWS), Section 11 - Countertops, Custom Grade and with manufacturer's requirements.
- B. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over structural substrate/core material.
 1. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
 2. Core: Fabricate solid surface countertop core of manufacturer's recommended moisture-resistant MDF. Provide continuous structural substrate at unsupported/overhang conditions; ladder construction acceptable over cabinets. Build up core material for total countertop thickness indicated.
 3. Fabricate in accordance with manufacturer's standard requirements, and in one piece to the greatest extent possible.
 - a. Shop-fabricate cutouts and holes in solid surface for plumbing fixtures, deck-mounted soap dispensers, and other items indicated on Drawings.
 4. Provide manufacturer's standard configuration for exposed edges, back and end splashes, and per the requirements below:
 - a. Edge and Corner Profiles: Eased.
 - b. Provide built up edges to standard thickness indicated (1-1/2 inches unless otherwise indicated).
 - c. Provide 4 inch high back and end splashes, unless otherwise indicated.

2.07 ACCESSORIES & ACCESSORY MATERIALS

- A. Trash/Recycle Bin Grommets: Stainless steel grommets for circular countertop cut-outs; satin finish.
 1. Grommet Size: Unless otherwise indicated, provide 12-inch diameter, by 3-inch depth. Basis-of-Design is Doug Mockett TM12B-SSS.

2.08 DETENTION CASEWORK

- A. Fabricate casework indicated on the Drawings as "Detention Casework," or casework that is located within Detention areas, in accordance with AWI/AWMAC/WI (AWS) Premium grade. Locate equipment consoles, cabinets, and countertops in locations and configuration as indicated on Drawings.
 1. Provide plastic laminate casework utilizing particleboard core material as specified for general Division 06 casework.
 2. Provide solid surfacing countertops utilizing veneer-core plywood subtop.
- B. Solid Surface Countertops: Fabricate in accordance with AWI/AWMAC/WI (AWS) Premium grade and the following additional requirements:
 1. Countertops shall be constructed of 1/2 inch thickness solid-surface material with 3/4 inch veneer-core plywood subtop.
 2. Unsupported countertop spans shall not exceed 48 inches, and shall be reinforced to prevent deflection in excess of 1/4 inch under a 100 lb per square foot load.

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3. The maximum distance a solid-surface material countertop (with or without subtop) may cantilever from a support is 12 inches for 3/4 inch thick, or 6 inches for 1/2 inch thick material, whether in the front, back, or end.
 4. Install solid-surface countertops with support adequately furnished to minimize stresses and maximum full perimeter and joint support on all horizontal applications with a maximum on center separation between supports of 24" and with a maximum unsupported and unloaded overhang of 6" for countertop with subtop.
- C. Provide the following hardware items in addition to hinges, shelf supports, and basic items specified for general casework applications:
1. Provide recessed door and drawer pulls, in lieu of the back-mounted wire pulls specified for non-security applications.
 2. Provide grommets and wiretray required for installation of equipment items.
 3. Provide locks for all drawers and doors.
- D. Mount security control equipment within or on consoles as indicated on Drawings.
1. Coordinate equipment requirements with the Security Control System Contractor (SCSC) prior to submitting shop drawings. Show coordination of detention equipment on the shop drawings.
 2. Locate wire management slots in countertop of size and location required to install monitors and keyboard with minimal exposure of wires from the countertop view. Finish wire management slots with vinyl grommets as specified.
 3. Provide for and coordinate installation of hopper pass and package pass units specified in Division 11 detention equipment sections.

2.09 FABRICATION

- A. Assembly: Shop assemble casework items for delivery to site in units easily handled and to permit passage through building openings.
- B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
1. Fittings and Fixture Locations: Cut and drill components for fittings and fixtures.
 2. Scribes and Fillers: Panels of matching construction and finish, for locations where cabinets do not fit tight to adjacent construction.
 3. Seal or prime paint concealed cut edges of wood and laminate casework.
- D. Hardware Application: Factory-machine casework members for hardware that is not surface applied.
- E. Apron Frames: Construction similar to other cabinets, with modifications.
1. Frames fabricated from panels standard with the manufacturer. Include front and back panels, with drawer suspension framing mechanically fastened to support channels spanning between them.
- F. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel exposed edges.
- G. Solid Surfacing: Fabricate in one piece to greatest extent possible; join pieces with adhesive sealant and finish joints smooth in accordance with manufacturer's recommendations and instructions.

1. Fabricate with butt-jointed / square edge at all solid surface corners. Mitered solid surface corners are not acceptable.
- H. Countertop Fabrication: Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
 1. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall, or as indicated.
 2. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
- I. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
 1. Height: 4 inches, unless otherwise indicated.
 2. Mechanically fasten back and end splashes to countertops with steel brackets at 16 inches on center.
- J. Wall-Mounted Counters (not mounted over cabinets): Provide ADA compliant knee space with brackets, skirts, or aprons, as indicated on Drawings.

2.10 SHOP FINISHING

- A. Sand work smooth and set exposed nails and screws.
- B. On items to receive transparent finishes, use wood filler matching or blending with surrounding surfaces and of types recommended for applied finishes.
- C. Finish work in accordance with AWI/AWMAC/WI (AWS), Section 5 - Finishing for grade specified and as follows:
 1. Transparent:
 - a. System - 3, Lacquer, Postcatalyzed OR System - 5, Varnish, Conversion.
 - b. Stain: As selected by Architect.
 - c. Sheen: Satin.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Site Verification of Environmental Conditions:
 1. Do not deliver woodwork or casework until the following conditions have been met:
 - a. Building has been enclosed (windows and doors sealed and weather-tight).
 - b. An operational HVAC system that maintains temperature and humidity at occupancy levels has been put in place.
 - c. Ceiling, overhead ductwork, piping, and lighting have been installed.
 - d. Installation areas do not require further "wet work" construction.
- B. For Base Cabinets Installation: Examine floor levelness and flatness of installation space. Do not proceed with installation if encountered floor conditions required more than 1/2 inch leveling adjustment. When installation conditions are acceptable, for each space, establish the high point of the floor. Set and make level and plumb first cabinet in relation to this high point, and provide field modifications as required to not exceed maximum height dimensions.
 1. Construction tolerances shall not apply to casework maximum height dimensions; maximum indicated dimension shall be maintained at any point along the length of casework, regardless of floor levelness.

2. Field modifications shall be made to the toe kick to account for leveling due to floor levelness.
- C. For Wall Cabinets Installation: Examine wall surfaces in installation space. Do not proceed with installation if the following conditions are encountered:
 1. Maximum variation from plane of masonry wall exceeds 1/4 inch in 10 ft and 1/2 inch in 20 ft or more, and/or maximum variation from plumb exceeds 1/4 inch per story.
 2. Maximum Variation of finished gypsum board surface from true flatness: 1/8 inch in 10 feet in any direction.
- D. Verify adequacy of backing and support framing.
- E. Verify location and sizes of utility rough-in associated with work of this section.

3.02 INSTALLATION

- A. Install work in accordance with AWI/AWMAC/WI (AWS) requirements for grade(s) indicated and in accordance with manufacturer's instructions.
- B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
- C. Use fixture attachments in concealed locations for wall mounted components.
- D. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.
- E. Secure cabinets to floor using appropriate angles and anchorages.
- F. Fasten together cabinets in continuous runs, with joints flush, uniform and tight. Misalignment of adjacent units not to exceed 1/16 inch. In addition, do not exceed the following tolerances:
 1. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet.
 2. Variation of Bottoms of Wall Cabinets from Level: 1/8 inch in 10 feet.
 3. Variation of Faces of Cabinets from a True Plane: 1/8 inch in 10 feet.
 4. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch.
 5. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch.
- G. Secure wall cabinets at top and bottom, at each end and no more than 16 inches on center. Secure directly into metal wall framing, or into FRT wood or metal channel blocking with No. 10 wafer head screws. Wall mounted hanger strips are not acceptable.
- H. Countertops: Install countertops intended and furnished for field installation in one true plane, with ends abutting at hairline joints, and no raised edges.
- I. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

3.03 ADJUSTING

- A. Test installed work for rigidity and ability to support loads.
- B. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

- A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

3.05 PROTECTION

- A. Do not permit finished casework to be exposed to continued construction activity.
- B. Protect casework and countertops from ongoing construction activities. Prevent workmen from standing on, or storing tools and materials on casework or countertops.

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- C. Repair damage, including to finishes, that occurs prior to Date of Substantial Completion, using methods prescribed by manufacturer; replace units that cannot be repaired to like-new condition.

END OF SECTION 064100

SECTION 070152 - PREPARATION FOR FLUID-APPLIED ROOFING

PART 1 GENERAL

1.01 DEFINITIONS

- A. Removal: Remove and legally dispose of items except those indicated to be reinstalled, salvaged, or to remain property of the Owner.
- B. Existing to remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Engineer, items may be removed to a suitable, protected storage location during selective demolition and then cleaned and reinstalled in their original locations.
- C. Material ownership: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain the Owner's property, demolished materials shall become the Contractor's property and shall be removed from the site.

1.02 EXISTING ROOF ASSEMBLIES*

- A. Roof Sector A:
 - 1. Roofing generally consists of a modified bitumen membrane roof membrane system adhered to gypsum coverboard adhered to tapered polyisocyanurate insulation adhered to hollow core concrete deck planks with associated sheet metal flashings and membrane flashings.
 - a. Roof drains to 22 through-wall primary scuppers at the base of the masonry walls.
 - b. Roof edge height is approximately 19 feet above grade.
 - c. There is no existing slope in the structure.
- B. Roof Sectors B and C:
 - 1. Roofing generally consists of Pre-Fabricated Insulated Pavers laid over modified bitumen membrane adhered to gypsum coverboard adhered to polyisocyanurate insulation adhered to hollow core concrete deck planks with associated sheet metal flashings and membrane flashings.
 - a. Roof drains to gutters at the roof edges.
 - b. Roof edge height is approximately 19 feet above grade.
 - c. There is existing slope in the structure.

*Roof system composition is based on random sampling. Contractor is responsible for verification of roof system composition.

1.03 SUBMITTALS

- A. Refer to Section 01 33 00-Submittal Procedures for Submittals.
- B. Manufacturer's Product Data Sheets for all materials specified certifying material complies with this specification.

PART 2 PRODUCTS

2.01 MECHANICAL EQUIPMENT ACCESSORIES

- A. Conduit and Pipe Supports: Specifically manufactured to provide support for roof-mounted conduit and pipes, adjustable height, polycarbonate rectangular base, such as Pillow Block Pipestand Model No. 16-Base Strut-12 as manufactured by Miro Industries, Inc. or alternates as approved by Engineer.
- B. Walk Pads: Walk pads as recommended by the fluid-applied membrane manufacturer providing the roof system warranty.

2.02 MISCELLANEOUS MATERIALS

- A. Rust Converter: Synthetic emulsion applied to light rust areas, acts as primer upon drying.
- B. Primer: Quick-drying, oil-based primer for exterior use.
- C. Paint: Acrylic epoxy coating such as Devran 229H Acrylic Epoxy Gloss Coating as manufactured by Devoe, Acrylic Epoxy as manufactured by Duron, or M43Acrylic Epoxy Coating as manufactured by Benjamin Moore & Co. Color selected by Owner.
- D. Torched MB Base Ply: Glass fiber or polyester reinforced ply sheet manufactured for torch application. Product to meet or exceed minimum standards of ASTM D 6163 (glass fiber reinforced) or ASTM D 6164 (polyester reinforced), Type I or II, Grade S.
- E. Torched MB Cap Sheet: Glass fiber or polyester reinforced ply sheet manufactured for torch application. Product to have a minimum weight of 100 pounds per square and meet or exceed minimum standards of ASTM D 6163 (glass fiber reinforced) or ASTM D 6164 (polyester reinforced), Type I or II, Grade G. Granules to be white.
- F. Gypsum Coverboard: ASTM C 728, non-structural gypsum board with embedded glass mat, pre-primed, thickness ½ inch.
- G. Polyisocyanurate Roof Insulation: ASTM C 1289, Type II, Class 1, manufactured to the following requirements:
 - 1. Minimal compressive strength: 20 psi.
 - 2. Dimensional stability: 2% maximum linear change when conditioned at 158°F and 97% relative humidity for seven days.
 - 3. Minimum curing time: 24 hours minimum, plus 24 hours for each inch of thickness at a minimum of 60°F before shipment from manufacturer.

4. Board size as required, 1 inch thick.

H. Insulation Adhesive: Two component, low rise polyurethane foam, approved for adhering polyisocyanurate insulation to concrete decking and adhering the gypsum coverboard to the polyisocyanurate insulation.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Survey existing conditions to determine extent of demolition.
- B. Record the conditions of items to be removed/reinstalled and items to be removed/salvaged.
- C. Contractor shall not remove any element that may result in structural deficiency or collapse of any part of the structure or adjacent structures during demolition.
- D. Contractor to inspect substrate for soundness and notify Engineer in writing of any deficiencies. Commencement of work signifies Contractor's acceptance of site conditions.

3.02 UTILITIES/SERVICES

- A. Maintain existing utilities that are to remain in service and protect them against damage during selective site demolition unless authorized in writing by the Owner and authorities having jurisdiction.
 - 1. If utilities serving occupied portions of the site must be shut down, temporary services shall be provided.
 - 2. Provide 72 hours notice to Owner if shut down is required.
 - 3. Where services are to be removed, relocated or abandoned, provide necessary bypass connections to remaining occupied buildings and areas.

3.03 PREPARATION

- A. Do not begin demolition until utilities have been disconnected/sealed and have been verified as such in writing.
- B. Do not close off or obstruct streets, walks or other adjacent occupied facilities without permission from Owner and authorities having jurisdiction.
- C. Provide safe conditions for pedestrians. Erect temporary protection such as walkways, fences, railings and canopies as required by OSHA and other governing authorities.
- D. Provide protection for adjacent buildings, appurtenances and landscaping to remain. Erect temporary fencing around trees to remain.
- E. Provide temporary weather protection as required to prevent water leakage and damaged to exterior or interior of adjacent structures.

3.04 POLLUTION CONTROLS

- A. Use water, mist, temporary enclosures and other suitable methods to limit the spread of dust and dirt. Comply with local EPA regulations.
 - 1. Do not use water where damage may occur or where hazardous conditions would be created such as ice or flooding.

3.05 REMOVALS

- A. Demolish and remove existing construction only to the extent required by new construction.
- B. Roof Sectors B and C: Remove and salvage for reinstallation the edge metal at the roof rake edges.
- C. Roof Sectors B and C: Remove and salvage for reinstallation the perforated sheet metal securement components at the roof edges.
- D. Roof Sectors B and C: Remove Pre-Fabricated Insulated Pavers. Salvage and store the Pre-Fabricated Insulated Pavers in good condition.
- E. Roof Sectors B and C: At any locations marked indicating the presence of wet insulation, remove the MB roof membrane, gypsum coverboard and polyisocyanurate insulation to the concrete deck as follows:
 - 1. Remove MB membrane and gypsum cover board 12 inches beyond the marked area.
 - 2. Remove all wet insulation to the hollow core concrete plank deck.
- F. Remove and dispose of all loose membrane, loose granules and roof surface debris.
- G. Roof Sector A: Remove and salvage for reinstallation the existing sheet metal slip flashings where indicated.
- H. Roof Sector A: Remove and salvage for reinstallation the sheet metal curb covers where indicated.
- I. Roof Sector A: Remove and dispose of the existing HVAC condensate line supports.
- J. Remove debris from existing materials to provide clean, dry substrate.
- K. Remove and transport debris in a manner that will prevent damage/spills to adjacent buildings and areas.
- L. Dispose of demolished items and materials on a daily basis. On-site storage of removed items is not permitted.
- M. Transport demolished materials off-site and dispose of materials in a legal manner.
- N. Perform progress inspections to detect hazards resulting from demolition activities.

3.06 INSTALLATION, GENERAL

- A. Provide screws, bolts, fasteners and other accessories of the type best suited for the intended purpose and compatible with materials being joined or contacted.
- B. Workmanship shall be first-class in every respect. All work shall be assembled and secured in accordance with these specifications, the manufacturers' requirements, and referenced standards.
- C. Follow industry guidelines, manufacturers' guidelines and these specifications to ensure quality of workmanship.

3.07 CONDENSATE LINE SUPPORT INSTALLATION

- A. At air conditioning units, provide new condensate drain line supports and underlying walkpad at new and existing condensate drain line locations. Space drain line supports at 4 feet on center maximum. Provide one additional support at every turn and termination.
- B. Cut strips of walkway units for installation under condensate drain line supports from new full-size walkway units. Cut strips a minimum of 6 inches wider and longer than condensate drain line support.
- C. Provide metal brackets to secure drain line to support.
 - 1. Provide one additional support at every turn and termination.

3.08 INSTALLATION OF INSULATION, COVERBOARD AND MB MEMBRANE

- A. See Detail 1/5.2 and as follows:
 - 1. Where wet insulation is removed, fill the void with new 1 inch thick polyisocyanurate insulation adhered with ribbons of the two component, low rise polyurethane foam adhesive. Ribbon spacing shall be 6 inches o.c with a minimum of 2 ribbons per board.
 - 2. Where gypsum cover board is removed, fill the void with new 1/2 inch thick gypsum cover board adhered with ribbons of the two component, low rise polyurethane foam adhesive. Ribbon spacing shall be 6 inches o.c with a minimum of 2 ribbons per board.
 - 3. Embed the existing cap sheet granules a minimum of 10 inches onto the existing MB membrane.
 - 4. Torch apply the new MB Base Ply extending a minimum of 6 inches onto the existing MB membrane.
 - 5. Torch apply the new MB Cap Sheet extending a minimum of 4 inches beyond the new MB Base Ply onto the existing MB membrane.

3.09 PAINTING OF ROOF-MOUNTED EQUIPMENT AND EXPOSED STEEL

- A. At rusted equipment, sheet metal hoods, and exposed steel, finish as specified herein.
 - 1. Wire brush to remove loose rust, leaving light rust in place. Remove loose paint.

2. Follow manufacturer's application requirements.
3. Allow materials to dry between applications.
4. Apply rust converter to all rusted surfaces.
5. Apply primer to all non-rusted surfaces.
6. Apply two coats of paint to all surfaces in a color to suit Owner.

3.10 CLEANING

- A. Inspect the site daily and clean up debris and hazards at the end of each day. Adjacent roads, drives and walkways shall remain in operation and free from construction materials debris.
- B. Clean adjacent structures of dust dirt and debris. Return adjacent areas to original conditions to the satisfaction of the Owner.

END OF SECTION 070152

SECTION 072216 - ROOF BOARD INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Description of Work: Flat insulation to be installed on Sectors B and C in the project.
- B. Related work specified elsewhere:
 - 1. Section 070152, "Preparation for Fluid-Applied Roofing"
 - 2. Section 075600, "Fluid-Applied Roofing"
 - 3. Section 076200, "Sheet Metal Flashing and Trim", for paver edge securement requirements.

1.02 DESCRIPTION

- A. Sectors B and C:
 - 1. Two-inch pre-fabricated, insulated pavers to match the existing, set over the Fluid-Applied Roofing membrane.

1.03 SUBMITTALS

- A. Refer to Section 01 33 00, Submittals, for requirements.

1.04 QUALITY ASSURANCE

- A. Install insulation in accordance with their respective Manufacturer's requirements.
- B. Insulation no bearing UL label at point of delivery shall be rejected.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery: Deliver materials in the manufacturer's original sealed and labeled containers and in quantities required to allow continuity of application.
- B. Storage: Store materials out of direct exposure to the elements on pallets or dunnage at least 4 inches above ground level at site location acceptable to the Owner.
 - 1. Utilize tarps that will completely cover materials to prevent moisture contamination. Remove or slit factory shrouds and or visqueen; do not use these materials as tarps.
 - 2. Install vapor retarders under material storage areas located on the ground.
 - 3. Remove damaged or deteriorated materials from the job site.
- C. Handling: Handle material in such manner as to preclude damage and contamination with moisture or foreign matter.

1.06 JOB CONDITIONS

- A. Do not apply materials during precipitation. Do not start application in the event there is a probability of precipitation during applications.
- B. Take necessary action to restrict dust and debris from entering the structure.
- C. Do not remove more existing roofing than can be replaced with insulation, membrane and base flashings in the same day.

1.07 INSULATION BOARDS

- A. Pre-Fabricated Insulated Pavers: ASTM D 578, Type VI, extruded polystyrene factory-bonded to 3/8-inch cementitious surfacing. Paver to provide minimum R-10.

1.08 INSULATION ACCESSORIES

- A. Cant Strip: ASTM C 728, minimum 4-inch mineral perlite cant factory formed to 45°.

PART 2 EXECUTION

2.01 INSPECTION

- A. Inspect substrate for soundness and notify Engineer in writing of any deficiencies.
- B. Commencement of work signifies Contractor's acceptance of substrate. Any defects in work resulting from such acceptance shall be corrected to Owner's satisfaction at no additional expense.

2.02 APPLICATION

- A. After installation of the Fluid-Applied Roofing membrane is complete, loose-lay new and salvaged insulated pavers in accordance with paver manufacturer's latest written instructions.
- B. Begin installation at corner of roof, working from bottom of slope to top.
- C. Stagger boards between rows, ensuring tongue-and-groove assembly is fully engaged into adjacent boards. Gaps greater than 1/4 inch are not permitted.
- D. Place long edge of boards in the direction of roof slope.
- E. Cementitious topping must not contact membrane materials at parapet wall. Bevel insulation to conform to membrane cant strip.
- F. Terminate boards at roof edges and parapet per the manufacturer. Refer to Section 07 62 00 for metal restraint installation.

END OF SECTION 072216

SECTION 074113
METAL ROOF PANELS
METAL ROOF PANELS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).
- B. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- D. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
- E. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
- F. ASTM E1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.
- G. ASTM E1646 - Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference.
- H. ASTM E1680 - Standard Test Method for Rate of Air Leakage through Exterior Metal Roof Panel Systems.
- I. FM 4470 - Examination Standard for Single-Ply, Polymer-Modified Bitumen Sheet, Built-Up Roof (BUR) and Liquid Applied Roof Assemblies for Use in Class 1 and Noncombustible Roof Deck Construction.

1.02 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Storage and handling requirements and recommendations.
 - 2. Installation methods.
 - 3. Specimen warranty.
 - 4. Include confirmation from metal roof panel manufacturer that submitted snow guard attachment is compatible with roof panel standing seam configuration and warranty requirements.
- B. Shop Drawings: Include layouts of roof panels, details of edge and penetration conditions, spacing and type of connections, flashings, underlayments, and special conditions.
 - 1. Show work to be field-fabricated or field-assembled.
- C. Selection Samples: For each roofing system specified, submit color chips representing manufacturer's full range of available colors and patterns.
- D. Verification Samples: For each roofing system specified, submit samples of minimum size 12 inches square, representing actual roofing metal, thickness, profile, color, and texture.
- E. Installer's qualification statement.
- F. Test Reports: Indicate compliance of metal roofing system to specified requirements.

- G. Warranty: Submit specified manufacturer's warranty and ensure that forms have been completed in Owner's name and are registered with manufacturer.

1.03 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified and approved by manufacturer for installation of specified products.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Provide strippable plastic protection on prefinished roofing panels for removal after installation.
- B. Store roofing panels on project site as recommended by manufacturer to minimize damage to panels prior to installation.

1.05 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Finish Warranty: Provide manufacturer's special warranty covering failure of factory-applied exterior finish on metal roof panels and agreeing to repair or replace panels that show evidence of finish degradation, including significant fading, chalking, cracking, or peeling within specified warranty period of twenty (20) years from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Structural Metal Roof Panel Manufacturers:
1. ATAS International, Inc; Belvedere Grand R.
 2. Berridge Manufacturing Company; R-Panel.
 3. Construction Metal Products; PBR Panel.
 4. Drexel Metals Inc.; R-Panel.
 5. MBCI; PBR Panel.
 6. Metal Roofing Systems Inc; PBR Panel.
 7. Metal Sales Manufacturing Corp; PBR-Panel.
 8. Substitutions: See Section 016000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

- A. Metal Roof Panels: Provide complete roofing assemblies, including roof panels, clips, fasteners, connectors, and miscellaneous accessories, tested for compliance with the following minimum standards:
1. Structural Design Criteria: Provide panel assemblies designed to safely support design loads at support spacing indicated, with deflection not to exceed L/180 of span length(L) when tested in accordance with ASTM E1592.
 - a. Dead Loads: Weight of roofing system.
 - b. Live Loads: As required by ASCE 7 and as indicated on Structural Drawings.
 2. Overall: Complete weathertight system tested and approved in accordance with ASTM E1592.
 3. Air Infiltration: Maximum 0.06 cfm/sq ft at air pressure differential of 1.57 lbf/sq ft, when tested according to ASTM E1680.
 4. Water Penetration: No water penetration when tested according to procedures and recommended test pressure of 2.86 lbf/sq. ft. according to ASTM E1646.

5. Thermal Movement: Design system to accommodate without deformation anticipated thermal movement over ambient temperature range of 120 degrees F.
6. Accelerated Weathering Test: Demonstrate physical integrity over the working life of the roof based upon 2,000 hours of exposure to accelerated weathering tests conducted in accordance with ASTM G152, ASTM G155, or ASTM G154.
7. Impact Resistance: Resist impact damage based on the results of tests in accordance with ASTM D3746, ASTM D4272, CGSB 37-GP-52M, or the "Resistance to Foot Traffic Test" in Section 5.5 of FM 4470.

2.03 STRUCTURAL METAL ROOF PANELS

- A. General: Provide complete engineered system complying with specified requirements and capable of remaining weathertight while withstanding anticipated movement of substrate and thermally induced movement of roofing system.
- B. Structural Metal Panels: Factory-formed panels with factory-applied finish.
 1. Steel Panels:
 - a. Zinc-coated SS (structural steel) sheet complying with ASTM A653/A653M; minimum G60 galvanizing.
 - b. Aluminum-zinc alloy-coated SS (structural steel) sheet complying with ASTM A792/A792M; minimum AZ50 coating.
 - c. Steel Thickness: Minimum 24 gauge, 0.024 inch.
 2. Profile: Lapped seam, with trapezoidal ribs, with overlapping end rib with integral sealant bead and exposed fastener system.
 3. Length: Maximum possible length to minimize lapped joints.
 4. Total Width: Total panel coverage of 36 to 39 inches as standard with manufacturer.
 - a. Width Between Primary Ribs: 12 to 13 inches.
 - b. Provide two intermediate stiffening ribs between primary ribs.
 5. Rib Height: 1-1/4 inches.

2.04 ATTACHMENT SYSTEM

- A. Concealed System: Provide manufacturer's standard stainless steel or nylon-coated aluminum concealed anchor clips designed for specific roofing system and engineered to meet performance requirements, including anticipated thermal movement.
 1. Provide a combination of fixed and floating clips to provide point of fixity at center of panel lengths; allowing for equal thermal movement toward each end.
- B. Exposed System: Provide manufacturer's recommended stainless steel fasteners engineered to meet performance requirements and equipped with appropriate sealant separators to provide weathertight connections that will accommodate anticipated thermal movement.

2.05 FABRICATION

- A. Panels: Provide factory or field fabricated panels with applied finish and accessory items, using manufacturer's standard processes as required to achieve specified appearance and performance requirements.
 1. Portable Roll-Forming Equipment for Field-Fabricated Panels: Where panel length exceeds transportation capacity, use of UL-certified portable roll-forming equipment to produce full length panels on site is acceptable. Panels shall be warranted by manufacturer to be same as factory-formed products. Maintain UL certification of equipment for duration of the Work.

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- B. Joints: Provide captive gaskets, sealants, or separator strips at panel joints to ensure weathertight seals, eliminate metal-to-metal contact, and minimize noise from panel movements.

2.06 FINISHES

- A. Fluoropolymer Coil Coating System: Manufacturer's standard multi-coat aluminum coil coating system complying with AAMA 2605, including at least 70 percent polyvinylidene fluoride (PVDF) resin, and at least 80 percent of coil coated aluminum surfaces having minimum total dry film thickness (DFT) of 0.9 mil, 0.0009 inch; color and gloss as selected by Architect from manufacturer's full range.
- B. Concealed Surfaces: For interior surfaces of panels that will not be exposed in the finished work, provide epoxy primer and light-colored silicone-modified polyester (SMP) enamel or acrylic enamel topcoat, with minimum dry film thickness (DFT) of 0.5 mil.

2.07 ACCESSORIES

- A. Miscellaneous Sheet Metal Items: Provide flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, and equipment curbs of the same material, thickness, and finish as used for the roofing panels. Items completely concealed after installation may optionally be made of stainless steel.
- B. Rib and Ridge Closures: Provide prefabricated, close-fitting components of steel with corrosion resistant finish or combination steel and closed-cell foam.
- C. Sealants:
 - 1. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.
 - 2. Concealed Sealant: Non-curing butyl sealant or tape sealant.
 - 3. Seam Sealant: Factory-applied, non-skinning, non-drying type.
- D. Deck Sheathing: PS 1, Exterior bond classification, 23/32 or 3/4 PERF CAT; veneer faced plywood. OSB is not acceptable.
- E. High-Temperature Underlayment: Self-adhering rubber-modified asphalt sheet complying with ASTM D1970/D1970M; 30 mil minimum total thickness; with strippable release film and slip-resistant woven polypropylene or polyethylene sheet top surface.
 - 1. Self Sealability: Nail sealability in accordance with ASTM D1970/D1970M.
 - 2. Low Temperature Flexibility: Comply with ASTM D1970/D1970M.
 - 3. High Temperature Resistance: Passes thermal stability test at 240 degrees F, as specified in ASTM D 1970.
 - 4. Products:
 - a. Carlisle Coatings and Waterproofing; WIP 300HT.
 - b. Drexel Metals; MetShield.
 - c. GCP Applied Technologies, Inc.; Ultra.
 - d. Henry Company; Blueskin PE200HT.
 - e. Kirsch Building Products, LLC; Sharkskin Ultra SA.
 - f. Owens Corning; WeatherLock Metal High Temperature Underlayment.
 - g. Polyglass USA, Inc; Polystick MTS Self-Adhered High Temperature Roof Underlayment.
 - h. Substitutions: See Section 016000 - Product Requirements.

2.08 SNOW GUARDS

- A. Bar-Type Snow Guard: Continuous snow guard; provide manufacturer's standard assembly with an extruded aluminum bar/channel with slot for insertion of metal trim piece matching roof panel color. Metal panel manufacturer shall coordinate to provide matching metal trim.
 - 1. Clamps for Standing Seam Roof: Structural aluminum or stainless steel clamps secured to vertical standing seams of roof panels; non-penetrating.
 - 2. Products:
 - a. Alpine SnowGuards; SnowMax.
 - b. AceClamp by PMC Industries, Inc; Color Snap.
 - c. S-5!; ColorGard.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation of preformed metal roof panels until substrates have been properly prepared.

3.02 PREPARATION

- A. Coordinate roofing work with provisions for roof drainage, flashing, trim, penetrations, and other adjoining work to ensure that completed roof will be free of leaks.
- B. Remove protective film from surface of roof panels immediately prior to installation; strip film carefully to avoid damage to prefinished surfaces.
- C. Separate dissimilar metals by applying a bituminous coating, self-adhering rubberized asphalt sheet, or other permanent method approved by metal roof panel manufacturer.
- D. At locations where metal will be in contact with wood or other absorbent material subject to wetting, seal joints with sealing compound and apply one coat of heavy-bodied bituminous paint.

3.03 INSTALLATION

- A. Overall: Install roofing system in accordance with approved shop drawings and metal roof panel manufacturer's instructions and recommendations, as applicable to specific project conditions; securely anchor components of roofing system in place allowing for thermal and structural movement.
 - 1. Install roofing system with concealed clips and fasteners, except as otherwise recommended by manufacturer for specific circumstances.
 - 2. Install roofing system with exposed fasteners prefinished to match panels.
 - 3. Minimize field cutting of panels. Where field cutting is required, use methods that will not distort panel profiles. Use of torches for field cutting is prohibited.
- B. Accessories: Install necessary components that are required for complete roofing assembly, including flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, equipment curbs, rib closures, ridge closures, and similar roof accessory items.
- C. Underlayment: Apply primer to substrate if required per manufacturer's instructions. Install self-adhering high temperature underlayment full coverage across entire roof surface, as the layer directly under metal roof panels. Apply from eaves to ridge in shingle fashion, overlapping horizontal joints a minimum of 3-1/2 inches. Overlap side and end laps a minimum of 6 inches and stagger at least 24 inches between courses. Roll all laps with a roller.

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1. Comply with manufacturer's instructions for temperature and exposure requirements; but do not leave underlayment exposed for more than 14 days.
- D. Roof Panels: Install metal roof panels in accordance with manufacturer's installation instructions, minimizing transverse joints except at junction with penetrations.
 1. Form weathertight standing seams incorporating concealed clips, using an automatic mechanical seaming device approved by panel manufacturer.
 2. Install sealant or sealant tape at end laps and side joints as recommended by metal roof panel manufacturer.
- E. Snow Guards: Secure base clamps to metal roof panel seams at spacing recommended by manufacturer. Do not penetrate the metal roof panels. Provide one row of snow guards continuous along length of metal roofing, mounted at 24 inches up from gutter or eave, unless otherwise indicated.

3.04 CLEANING

- A. Clean exposed sheet metal work at completion of installation. Remove grease and oil films, excess joint sealer, handling marks, and debris from installation, leaving the work clean and unmarked, free from dents, creases, waves, scratch marks, or other damage to the finish.

3.05 PROTECTION

- A. Do not permit storage of materials or roof traffic on installed roof panels. Provide temporary walkways or planks as necessary to avoid damage to completed work. Protect roofing until completion of project.
- B. Touch-up, repair, or replace damaged roof panels or accessories before Date of Substantial Completion.

END OF SECTION 074113

SECTION 07 56 00 - FLUID-APPLIED ROOFING

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. Roof Sector A: Provide a cold-fluid-applied polyurethane roofing/waterproofing system on modified bitumen membrane roof surface.
 - 1. Work includes substrate preparation.
 - 2. Work includes bridging and sealing water intrusion pathways and gaps of the concrete/mortar and masonry surfaces and similar items.

1.3 PERFORMANCE REQUIREMENTS

- A. Cold fluid applied polyurethane roofing/waterproofing system is intended to perform as a continuous barrier against liquid water and to flash or discharge to the exterior incidental water. Membrane system is expected to remain exposed and shall accommodate movements of building materials as required with accessory sealant materials at such locations such as, changes in substrate, perimeter conditions and penetrations.
- B. Installed roofing/waterproofing membrane system shall not permit the passage of water.
- C. Manufacturer shall provide all primary roofing/waterproofing materials that are physically and chemically compatible when installed in accordance with manufacturers current application requirements.

1.4 SUBMITTALS

- A. Submittals: Comply with project requirements for submittals as specified in Division 01.
- B. Product Data: For each product.
- C. Shop Drawings: Manufacturer's standard details and shop drawings for the specified system.
- D. Installer's Authorization: Installer shall provide written documentation from the manufacturer of their authorization to install the system, and eligibility to obtain the warranty specified in this section.
- E. Manufacturer' Certification: Certification showing full time quality control of production facilities and that each batch of material is tested to ensure conformance with the manufacturer's published physical properties.

- F. VOC Certification: Manufacturer's certification that all roofing/waterproofing system products meet current Volatile Organic Compound (VOC) regulations as established by the State in which they are being installed; and stating total VOC content, in grams per liter, for all system components (i.e. primers, adhesives, coatings, etc.).

1.5 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Manufacturer shall demonstrate qualifications to supply materials of this section by certifying the following:
 - 1. Membrane Manufacturer shall show evidence that the specified membrane has been manufactured by the same organization or direct affiliate for fifteen years.
 - 2. Membrane Manufacturer shall have available an in-house technical staff to assist the contractor when necessary in the application of the products and site review of the assembly.
- B. Installer's Qualifications: The Contractor shall demonstrate qualifications to perform the Work of this Section by submitting certification or license by the roofing/waterproofing membrane manufacturer as a trained and authorized applicator of the product the installer intends to use.
- C. Source Limitations: All components listed in this section shall be provided by a single manufacturer or approved by the primary roofing/waterproofing manufacturer.
- D. Materials Compatibility: All materials included in the roofing/waterproofing assembly, as well as associated materials adhered to/applied beneath the roofing/waterproofing membrane shall have been tested and verified to be compatible. Include written testing documentation and test reports if requested by Engineer.
- E. Final Inspection: Manufacturer's representative shall provide to the Engineer a comprehensive site visit report after the completion of the roofing/waterproofing system
- F. Applicable Regulations: Comply with local code and requirements of authorities having jurisdiction. Do not exceed VOC regulations as established by the State in which they are being installed; including total VOC content, in grams per liter, for all system components (i.e. primers, adhesives, coatings, and similar items).
- G. Roofing and Waterproofing Terminology: Refer to ASTM D1079 and the glossary of the National Roofing Contractors Association (NRCA) Roofing and Waterproofing Manual for definitions of roofing terms related to this section.

1.6 PRE-INSTALLATION CONFERENCE

- A. Prior to scheduled commencement of the roofing/waterproofing installation and associated work, conduct a meeting at the project site with the installer, engineer/consultant, owner, manufacturer's representative and any other persons directly involved with the performance of the Work. The Installer shall record conference discussions and to include decisions and agreements reached (or disagreements), and furnish copies of recorded discussions to each attending party. The main purpose of this meeting is to review foreseeable methods and procedures related to the Work.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver all roofing/waterproofing materials to the site in original containers, with factory seals intact.
- B. Store all pail goods in their original undamaged containers in a clean, dry location within their specified temperature range.
- C. Do not expose materials to moisture in any form before, during, or after delivery to the site. Reject delivery of materials that show evidence of contact with moisture.
- D. Remove manufacturer supplied plastic covers from materials provided with such. Use "breathable" type covers such as canvas tarpaulins to allow venting and protection from weather and moisture. Cover and protect materials at the end of each work day. Do not remove any protective tarpaulins until immediately before the material will be installed.
- E. Materials shall be stored above 55°F (12.6°C) a minimum of 24 hours prior to application

1.8 PROJECT CONDITIONS

- A. Weather: Proceed with roofing/waterproofing only when existing and forecasted weather conditions permit. Membrane application can proceed when precipitation is imminent. Sikalastic RoofPro is capable of curing in immersion immediately after application. Visual marks in the form of pock marks may occur if uncured membrane is exposed to heavy rainfall, but is not considered a limiting factor in the performance of the roofing membrane. Ambient temperatures shall be above 36°F (2°C) when applying the roofing/waterproofing system.
- B. Ambient temperatures shall be above 45°F (7°C) when applying the Coatings for Surface Color described in Section 2.9.
- C. All surfaces to receive the roofing/waterproofing membrane shall be free from visible water, dew, frost, snow and ice. Application of roofing/waterproofing membrane shall be conducted in well ventilated areas.
- D. Roofing/Waterproofing Membrane:
 - 1. Roofing/waterproofing membrane is not intended to be exposed or in contact with a constant temperature below -22°F (-30°C) or in excess of 176°F (80°C). See technical data sheets for limitations, i.e., hot pipes and vents or direct steam venting.
 - 2. Specified roofing/waterproofing membrane is non-flammable and VOC compliant. Consult container, packaging labels and Safety Data Sheets (SDS) for specific safety information.
 - 3. Specified roofing/waterproofing membrane is resistant to gasoline, paraffin, fuel oil, mineral spirits, and moderate solutions of acids and alkalis, acid rain and detergents. Some low molecular weight alcohols can soften. Any exposure to foreign materials or chemical discharges shall be presented to membrane manufacturer for evaluation to determine any impact on the waterproof membrane assembly performance prior to warranty issuance.

- E. Contractor shall ensure adequate protection during installation of the roofing/waterproofing system.
- F. Specified roofing/waterproofing membrane may be used as a temporary roofing/waterproofing barrier when applied at a wet film thickness of 15-20 mils to a properly prepared deck. When the specified roofing/waterproofing membrane is used as a temporary roofing/waterproofing barrier the roofing/waterproofing membrane does not need to be removed prior to installation of the finished roofing/waterproofing system

1.9 WARRANTY

- A. Warranty: Provide manufacturer's standard warranty starting at the date of Substantial Completion. System warranty shall be for the following duration in accordance with specified system.
 - 1. Warranty Length: 20 years.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Basis-of-Design Manufacturer: Sika Corporation, 201 Polito Avenue, Lyndhurst NJ 07071. Ph: 800-933-SIKA (7452), www.sikausa.com.
- B. Substitutions: Comply with Section 01 25 00.
 - 1. As approved in writing prior to receipt of bid. Materials must meet or exceed the performance requirements set forth in ASTM D7311-07.
 - 2. Requests for substitution shall include evidence of satisfactory past performance in similar environment.
 - 3. Substitutions will not be considered that change the number of coats or do not meet specified dry film thicknesses.

2.2 ROOFING/WATERPROOFING SYSTEM

- A. Fluid-Applied Membrane System, 20 Year Warranty: Sikalastic RoofPro 20, Sika Reemat Premium:
 - 1. Base Layer: Sikalastic 641 Lo-VOC, 50 mils wet film thickness, 32 sf/gal coverage rate approx.
 - 2. Top Layer: Sikalastic 641 Lo-VOC, 30 mils wet film thickness; 53 sf/gal coverage rate approx.

2.3 MEMBRANES AND COATINGS

- A. Base embedment coat with Reemat Premium reinforcement shall be Sikalastic 641 Lo-VOC by Sika Corp, a single component, cold, fluid applied, moisture triggered, aliphatic, polyurethane base coat membrane.

- B. Top coat with Reemat Premium reinforcement shall be Sikalastic 641 Lo-VOC by Sika Corp, a single component, cold, fluid applied, moisture triggered, aliphatic, polyurethane top coat membrane.
- C. Base coat and top coat membranes shall be low in VOC's, and be a one component elastomeric polyurethane membrane that may be brush or roller applied. Membrane shall have the following physical properties and conforms to ASTM D7311-07: Standard Specification for Liquid Applied, Single Component, Moisture-Triggered, Aliphatic Polyurethanes used in Roofing.
- D. Liquid Property Requirements:
 - 1. Sikalastic 641 Lo-VOC:
 - a. VOC Content, ASTM D-2369-81: < 50 g/l
 - b. Volume Solids, ASTM D2697: 89% minimum.
 - c. Weight Solids: ASTM D1644: 92% minimum.
 - d. Sag Resistance, ASTM D4400: No sag at 700 micrometers (0.028 in. / 28 mil)
- E. Film Physical Property Requirements:
 - 1. Tensile Strength (Tension): ASTM D412: Minimum 1.86 MPa (270lb/in2)
 - 2. Elongation: ASTM D412 : MIN 200%.
 - 3. Accelerated Weathering FL/UV – 5000 Hours, ASTM G 154, No cracking or checking.
 - 4. Water Vapor Transmission, Permeability / Permeance: ASTM E96: Maximum 8.5 gms/m2/ day (0.033 perm-inches).
 - 5. Flexibility – Mandrel Bend, ASTM D522: Pass, no cracking or flaking.
 - 6. Tear Resistance, ASTM D625: Minimum 5.8 kN/m (33 lbf/in)
 - 7. Indentation Hardness, ASTM D2240: 82 Durometer Units (+/- 5 units)
 - 8. Dynamic Puncture Resistance, ASTM D5635: Minimum 15 joules (357 ft.poundals)
 - 9. Static Puncture Resistance, ASTM D5602: Minimum 20.7 kg. (45.5 lbs.)

2.4 MEMBRANE REINFORCEMENTS

- A. Reinforcement for the roofing/waterproofing membrane system shall be Sika Reemat Premium by Sika Corp, a conformable, random strand fiberglass mat specifically designed to provide greater impact resistance and greater resistance to excessive thermal and structural movement while maintaining elasticity and membrane film integrity.
- B. Supplemental reinforcement of the roofing/waterproofing membrane system shall be Sika Flexitape Heavy by Sika Corp, a nylon mesh specifically designed for local reinforcement of the roofing/waterproofing membrane at structural cracks, expansion joints and transitions between dissimilar materials or Sika Joint Tape SA by Sika Corp., a self-adhering polymeric rubberized tape with woven polyester facer.

2.5 FILLET BEAD AND PENETRATION SEALANT

- A. Sealant for fillet bead applications and membrane penetrations shall be Sikaflex® 11FC by Sika Corp., a one part polyurethane sealant suitable for fillet bead transition compound to be applied prior to the installation of the membrane system at changes in substrate direction, sealing reglet terminations, cracks in the substrate and penetrations of the roof /waterproofing system.

2.6 PRIMERS

- A. Primer for existing modified bitumen membrane roof surface, concrete, poured gypsum, masonry, wood, and ferrous metals shall be Sikalastic EP Primer by Sika Corporation, a two-component (epoxy resin and activator), Universal Primer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces and conditions are ready to accept the Work of this section. Notify Engineer in writing of any discrepancies. Commencement of the Work in an area shall mean Installer's acceptance of the substrate.
- B. Surfaces shall be sound, dry, clean and free of oil, grease, dirt, excess mortar or other contaminants. Fill voids, gaps and spalled areas in substrate to provide an even plane. Strike masonry joints full flush.

3.2 SURFACE/SUBSTRATE PREPARATION

- A. See Section 07 01 52 "Preparation for Fluid-Applied Roofing".
- B. Acceptable substrates include modified bitumen membrane, concrete, poured gypsum, masonry, wood and ferrous metals.
- C. Verify that the substrates are clean and smooth, free of depressions, waves, or projections, and properly sloped to drain. Ensure all preparatory Work is complete prior to applying membrane.
- D. All surfaces shall be blown clean using an air compressor to remove any remaining loose debris.
- E. All cracks and voids greater than 0.040 inches shall be routed and caulked with a polyurethane sealant. Allow to cure per roof /waterproofing membrane manufacturer's technical data sheets prior to over-coating with the specified roof /waterproofing membrane system.
- F. Membrane terminations shall be established prior to project start-up and documented in shop drawings.
- G. Use tape lines to achieve a straight edge detail.

3.3 PRIMING

- A. Modified bitumen membrane, concrete, poured gypsum, masonry, wood and ferrous metals:

1. Mix and apply specified primer, Sikalastic EP Primer, to surfaces by brush or roller at the application rate shown on the technical data sheet. Porous, rough or absorbent surfaces will decrease coverage rates.
2. Allow to cure and dry in accordance with manufacturer's technical data sheets.

3.4 MEMBRANE REINFORCEMENT

A. Reinforcement of Cracks Transition:

1. For all locations where the specified membrane system is to be applied directly to the substrate surface, provide reinforcement of cracks prior to applying the specified membrane system
2. For all non-moving cracks, rout and seal with Sikaflex polyurethane sealant.
3. For all horizontal-to-vertical transitions, provide a $\frac{3}{4}$ " x $\frac{3}{4}$ " Sikaflex polyurethane sealant cant.
4. Apply a minimum of a 3 inch wide strip of Sika Joint Tape SA directly or alternatively Flexitape Heavy membrane reinforcement of into a bed of liquid roofing/waterproofing membrane. Back roll reinforcement to fully embed reinforcement into the wet liquid polyurethane membrane. Add more liquid membrane as needed to fully embed the reinforcement.
5. Ensure reinforcement is not in tension during embedment.

3.5 COLD FLUID APPLIED FIELD MEMBRANE APPLICATION

- A. Install roofing/waterproofing membrane system in accordance with current technical data sheets and in accordance with Part 2 Section 2.2.
- B. Apply base embedment coat to horizontal surfaces and vertical wall surfaces by brush or with 1/2 inch – 3/4 inch nap roller to achieve a continuous and uniform minimum wet film thicknesses as specified in Part 2 Section 2.2.
- C. Immediately lay specified conformable membrane reinforcement into the wet base embedment coat. Reemat reinforcement is typically precut before application.
- D. Apply pressure to the membrane reinforcement with a roller as appropriate to fully embed and saturate the membrane reinforcement into liquid roofing/waterproofing material. Remove air pockets from under the membrane by rolling them out.
- E. Apply additional liquid material as required to ensure the membrane reinforcement is fully embedded and has conformed to the substrate without tenting or visible pinholes.
- F. Overlap sheets of Reemat membrane reinforcement a minimum of 2 inches in all directions.
- G. Extend membrane reinforcement vertically at adjacent wall surfaces in accordance with project details and specifications.
- H. When using fiberglass mat reinforcement, allow the base embedment coat to fully cure dry prior to the placement of top coat or other applications of the specified roofing/waterproofing material.

- I. Apply top coat by nap roller or brush to achieve a continuous and uniform minimum wet film thickness as specified in Part 2 Section 2.2.
- J. Install all flashings in accordance with manufacturer's construction details.

3.6 ROOFING/WATERPROOFING PROTECTION

- A. Protect roofing/waterproofing Work from other trades until completion.
- B. Provide temporary membrane tie-ins and water-stops at the end of each workday and remove prior to commencement of Work the following day.

3.7 CLEAN-UP

- A. Work areas are to be kept clean, clear and free of debris at all times.
- B. Do not allow trash, waste, and/or debris to collect on the existing roof area. Trash, waste, and/or debris shall be removed from the roof on a daily basis.
- C. All tools and unused materials shall be collected at the end of each workday and stored properly off of the existing roof surface and protected from exposure to the elements.
- D. Dispose of or recycle all trash and excess material in a manner conforming to current EPA regulations and local laws.
- E. If necessary, properly clean the existing roof surface after completion, and make sure the gutters are not clogged.
- F. Clean and restore all damaged surfaces to their original condition

END OF SECTION 075600

SECTION 075600.1 - ROOF MANUFACTURER'S ACKNOWLEDGMENT

Owner: Wake County

Project Name: Detention Annex Renovation

Project Address: 3400 Hammond Road, Raleigh, North Carolina

Roofing Contractor: _____

Address: _____

Telephone: _____

This is to advise the Owner that having thoroughly reviewed the Specifications and Drawings contained within the Project Manual dated October 13, 2025 for the above-titled project, we acknowledge that the roof system(s) and flashing system(s) specified are suitable for the issuance of the specified Manufacturer's warranty on this project and have been tested and approved for the wind uplift pressures outlined in the project specifications. Having reviewed the project requirements in detail, the Manufacturer will provide a written response of exceptions to the Engineer through the contractor before five (5) days of the bid due date or as otherwise outlined in the Instructions to Bidders, if conflicts exist between the Manufacturer's warranty requirements and the above listed documents. Exceptions not submitted accordingly are subject to rejection. The manufacturer also certifies that the installer is approved, authorized, or licensed by the manufacturer to install the specified roof system and is eligible to provide the specified manufacturer's warranty. The manufacturer will comply with the specified requirements for on-site technical support.

Print or type name of manufacturer's designated Liaison on this project

Telephone and Email

Roof Manufacturer's Company Name

Roof Manufacturer Representative's Signature Date

Roof Manufacturer Representative's Name Title

Roof Manufacturer's Address

END OF SECTION 075600.1

DETENTION ANNEX RENOVATION
WAKE COUNTY, NORTH CAROLINA
Architect's Project No: 642088

SECTION 075600.2 - CONTRACTOR'S TWO-YEAR WARRANTY

Know all men by these presents, that we, (Contractor) _____, having installed Fabric-Reinforced Fluid-Applied roofing system, flashings and sheet metal on Wake County Detention Annex Renovation under contract between Wake County (Owner) and Contractor, warrant to the Owner with respect to said work that for a period of two (2) years from date of Substantial Completion, the work shall be absolutely watertight and free from any and all leaks, provided however the following are excluded from this Warranty:

- a. Defects or failures resulting from abuse by the Owner.
- b. Defect in design involving failure of (1) structural frame, (2) load bearing walls, and (3) foundations.
- c. Damages caused by fire, tornado, hail, hurricane, acts of God, wars, vandalism, riots or civil commotion.

We, Contractor, agree that should any leaks occur in the work we will perform emergency repairs within 24 hours' notice and perform permanent repairs within a reasonable time in a manner to restore the work to a watertight condition by methods compatible to the system and acceptable under industry standards and general practice, all at no expense to the Owner.

We, Contractor, further agree that for a period of two (2) years from date of Substantial Completion referred to above, we will make repairs at no expense to the Owner to any defects which may develop in the work including but not limited to wrinkles, open laps, ridges, splits and loose flashing in a manner compatible to the system and acceptable under industry standards and general practice as established by the Engineer.

Date of Substantial Completion: _____

IN WITNESS WHEREOF, we have caused this instrument to be duly executed this _____, 20____

Signature: _____ Title: _____

State of North Carolina

_____ County

I, _____, a Notary Public for _____ County, North Carolina, do hereby certify that _____ personally appeared before me this day and acknowledged the due execution of the foregoing instrument.

Witness my hand and official seal, this _____ day of _____, 20_____.

Notary Public

(OFFICIAL SEAL)

My commission expires _____, 20_____.

END OF SECTION 075600.2

DETENTION ANNEX RENOVATION
WAKE COUNTY, NORTH CAROLINA
Architect's Project No: 642088

SECTION 075600.3 - ASBESTOS FREE WARRANTY

Owner: Wake County
Project Name: Wake County Detention Annex Renovation
Project Address: 3400 Hammond Road, Raleigh, North Carolina
Project Manual Date: October 13, 2025

Date of Substantial Completion: _____

Know all men by these present that we, _____
(Contractor, Subcontractor, Material Supplier or Equipment Manufacturer)

having furnished labor, materials, equipment and/or supplies; removed existing roof system; installed new roof system and/or miscellaneous roof system components; from, to and/or on the above referenced Project under contract between the Owner and Contractor, warrant to Owner with respect to said work that no materials containing asbestos fibers were incorporated into the work, and that, to our knowledge and belief, no materials containing asbestos remain in or are covered by the work.

Exceptions: _____
If there are no exceptions, state "No Exceptions" here.

Signature: _____

Title: _____

North Carolina

_____ County

I, _____, a Notary Public for _____ County, North Carolina, do hereby certify that _____ personally appeared before me this day and acknowledged the due execution of the foregoing instrument.

Witness my hand and official seal, this _____ day of _____, 20____.

Notary Public (OFFICIAL SEAL)

My commission expires _____, 20____.

END OF SECTION 075600.3

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Provide all detailed and necessary sheet metal at membrane terminations and penetrations.

1.02 SECTION INCLUDES

- A. Flashing, sheet metal and all accessories shall be of materials indicated and installed to provide a permanently watertight condition.
- B. Screws, bolts, fasteners and other accessories shall be the type best suited for the intended purpose and be compatible with materials being joined or contacted.
- C. Related work specified elsewhere:
 - 1. Section 075600, Fluid-Applied Roofing.

1.03 REFERENCE STANDARDS

- A. References in these specifications to standards, test methods, codes, etc., are implied to mean the latest edition of each such standard adopted. The following is an abbreviated list of associations, institutions and societies, which may be used as references throughout these specifications.
 - 1. North Carolina State Building Code.
 - 2. American Society for Testing and Materials (ASTM).
 - 3. National Roofing Contractors' Association (NRCA).
 - 4. SMACNA Architectural Sheet Metal Manual.

1.04 SUBMITTALS

- A. Refer to Section 013000, Administrative Requirements, for submittal requirements.

1.05 QUALITY ASSURANCE

- A. Install metal components to comply with the current SMACNA Architectural Sheet Metal Manual, 6th Edition, as applicable.
- B. Ensure completed work is free of leaks under all weather conditions.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery: Deliver materials in the manufacturer's original sealed and labeled containers and in quantities required to allow continuity of application.

- B. Storage: Store materials within areas designated or approved by the Owner. Ensure materials remain dry, covered and not in contact with the ground.
- C. Handling: Handle material in such manner as to preclude damage and contamination with moisture or foreign matter.

1.07 JOB CONDITIONS

- A. Environmental: Protect building and its components from the elements at all times during the project.
- B. Coordination and Scheduling: Coordinate all phases of work to allow continuity of work without delays.

PART 2 PRODUCTS

2.01 SHEET METAL MATERIALS

- A. Stainless Steel: 26 gauge, Type 304 as tested in accordance with ASTM A 167.
 - 1. Slip flashing.
- B. Stainless Steel: 22, Gauge, Type 304 as tested in accordance with ASTM A 167.
 - 1. Paver restraint.
- C. Stainless Steel: ASTM A 167, 18 ga., perforated with 1/4-inch diameter holes at 5/16-inch staggered centers.
 - 1. Paver securement.

2.02 MISCELLANEOUS MATERIALS

- A. Silicone Sealant: Shall be a one-component, non-sag, neutral cure, low-modulus, UV resistant, high performance silicone sealant. Shall meet ASTM C920, Type S, Grade NS, Class 100, Use M, G, A or O. Color to match adjacent materials.
- B. Sealant Tape: Minimum 1/2" wide non-skinning butyl sealant tape.

2.03 FASTENERS

- A. Provide fasteners that are rust-resistant and compatible with materials to be joined.
- B. Provide metal and EPDM washers on all exposed fasteners. Do not install exposed fasteners on horizontal surfaces.
- C. All exposed fasteners into masonry shall be metal based expansion anchor with stainless steel pin fastened through washers with stainless steel backing and EPDM washers, and fastened through oversized or slotted holes.

- D. Provide stainless steel fasteners at all locations where fastener will be used in pressure-treated lumber products.
- E. Washers: Shall be stainless steel with neoprene gasket backing. Shall be 9/16" diameter for use with #12 screws and 5/8" diameter for use with 1/4" diameter concrete and masonry anchors.
- F. Rivets: #44 stainless steel rivets with stainless steel mandrel. Length of rivet to properly fasten particular sheet metal components. Rivets shall be factory painted to match adjacent sheet metal.

PART 3 EXECUTION

3.01 INSPECTION

- A. Coordinate with other work for correct sequencing of items which make up the entire system.

3.02 PREPARATION

- A. All sheet metal flanges connected to the roof shall be installed per membrane manufacturer and these specifications.

3.03 INSTALLATION, GENERAL

- A. Provide screws, bolts, fasteners and other accessories of the type best suited for the intended purpose and compatible with materials being joined or contacted.
- B. Workmanship shall be first-class in every respect. The sheet metal work shall be assembled and secured in accordance with these specifications, the manufacturers' requirements, and referenced standards.
- C. The installation of sheet metal shall allow for thermal movement (expansion and contraction). Lengths of metal, fastening type and rate, metal joints, and connections shall all be installed to meet sheet metal industry recognized and published standards including those referenced herein.
- D. The various sheet metal sections shall be uniform with corners, joints, and angles mitered, sealed and secured.
- E. All exposed metal edges shall be returned (hemmed), both for strength and appearance, and sheet metal shall be fitted closely and neatly.
- F. Completed sheet metal components shall be true, level and straight. Tolerances shall meet those specified herein. Completed roof flashing and sheet metal components that do not meet the specified tolerances shall be rejected.
- G. All sheet metal details shall provide for redundancy including but not limited to self adhering membrane and/or sealants. This secondary protection shall be installed, sealed,

lapped, etc. to ensure if the sheet metal detail fails to shed water, a redundant layer of protection will be in place to shed limited moisture infiltration.

- H. Sheet metal joints shall be sealed with specified and compatible sealants. Joints shall be fastened and/or tightly fitted to prevent joints from buckling or opening.
- I. Completed work shall be free of leaks during all weather exposures required by the governing Building Code.
- J. Follow industry guidelines, manufacturers' guidelines and these specifications to ensure quality of workmanship.
- K. Completed roofing sheet metal assemblies shall provide watertight details at all roofing transitions.
- L. During construction, Contractor shall clean-up metal debris, fasteners, trash, etc.
- M. All joints to be locked and sealed as required.

3.04 SLIP FLASHING FOR CURBS

- A. Fabricate slip flashing at curbs and roof edges as shown in detail drawings in 10 foot lengths.
- B. Slip flashing shall extend a minimum of 2 inches below base flashing termination and shall fit tightly against curb or roof edge.
- C. Secure slip flashing 12 inches on center (plywood substrate) or at spacing to match metal stud spacing (at metal stud wall).
- D. Notch and lap ends of adjoining sections not less than 4 inches. Apply sealant tape between sections.
- E. Lap miters at corners a minimum of 1 inch and apply sealant between laps. Rivet at 2 inches on center.

3.05 RAKE EDGE METAL

- A. Reinstall the salvaged rake edge metal and secure in combination with the rake edge paver restraint metal.

3.06 PAVER RESTRAINT INSTALLATION

- A. Reinstall salvaged paver restraint metal at perimeter of roof areas as shown on Drawings.
- B. At rake and parapet (not including scupper locations) details, reinstall salvaged paver restraint over top surface of paver. Secure to paver with peel rivets spaced at 2 feet on center.
 - 1. Secure lower edge at rakes with hem of edge metal.

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WAKE COUNTY, NORTH CAROLINA
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2. Secure lower edge at parapets with fastener installed through wind clips.
-
- C. At gutter eaves, reinstall the salvaged perforated paver securement over top surface of paver. Secure to paver with peel rivets spaced at 2 feet on center. Secure lower edge with gasketed stainless steel screws through metal securement and gutter into wood blocking at 24 inches on center.

END OF SECTION 076200

**SECTION 077200
ROOF ACCESSORIES**

PART 1 GENERAL

1.01 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used.
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
 - 4. Maintenance requirements.
- B. Shop Drawings: Submit detailed layout developed for this project and provide dimensioned location and number for each type of roof accessory.

1.02 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store products under cover and elevated above grade.

PART 2 PRODUCTS

2.01 NON-PENETRATING ROOF EDGE PROTECTION RAILING

- A. Roof Edge Protection Railing: Freestanding pedestrian barrier system, including pipe railings, upright posts, bases, and fittings. Provide with corrosion-resistant powdercoat finish complying with AAMA 2604.
 - 1. Standards: Provide a railing system with horizontal top and mid rails, tested for a minimum structural load of 200 lb in any direction, in accordance with OSHA Regulation 29 CFR 1910.28, 1910.29, and 1926.502.
 - 2. Height: Installed height of 42 inches from roof surface to top of top rail. Midrail height 20 inches from roof surface to top of midrail.
 - 3. Mounting Bases: Manufacturer's standard, powdercoated, 90 lb cast iron, galvanized steel, or concrete filled PVC, with protective pads on bottom to protect roof surface.
 - 4. Posts and Rails: Minimum 1-1/2 inch diameter, 16 gauge steel, powdercoated or galvanized.
 - 5. Fittings: Provide manufacturer's standard fittings for a complete assembly. Post to base fitting shall have positive locking system that allows posts to be mounted in any direction. Friction locking is not permitted.
 - 6. Hardware: Provide manufacturer's standard securing carbon steel pins, zinc plated and yellow chromate dipped, consisting of collared pin and lanyard that connects to lynch pin.
 - 7. Accessories:
 - a. Toe Board Brackets: Provide system of adjustable metal brackets to secure LP-2 treated lumber toe boards to railing system. Include LP-2 PPTW toeboards in modular length to suit railing system.
 - b. Step-Rail: Variable height railing enables a continuous run of railing system when the roof steps up or down.
 - c. Raised Mid-Rail: Railing to fit over duct work for continuous run of railing system.
 - d. LP Outrigger: Supports placed under ducting or conduit to continue run of railing system when rail section cannot be used.

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- e. Gates: Provide railing systems manufacturer's fabricated pipe rail swinging or sliding gate assembly of opening size indicated. Include hinges, locking coupler, and accessories.
- f. Finishing Rail: D-shaped railing extension for ladder landings, length of rail section and D-loop as indicated on the Drawings.
- 8. Manufacturers:
 - a. BlueWater, by Tractel; SafetyRail 2000.
 - b. Garlock Safety Systems; Railguard 200 Railing System.
 - c. Kee Safety, Inc.; KeeGuard Contractor.
 - d. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.

3.04 CLEANING

- A. Clean installed work to like-new condition.

3.05 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 077200

**SECTION 078400
FIRESTOPPING**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems.
- C. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- D. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.
- E. ITS (DIR) - Directory of Listed Products.
- F. SCAQMD 1113 - Architectural Coatings.
- G. FM (AG) - FM Approval Guide.
- H. UL 1479 - Standard for Fire Tests of Penetration Firestops.
- I. UL (FRD) - Fire Resistance Directory.

1.02 SUBMITTALS

- A. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
- B. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- C. Installer's qualification statement.

1.03 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
 - 1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
 - 2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.
 - 3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.
- B. Labeling: Provide permanent labels adjacent to each firestopping assembly. Labels shall be durable metal or plastic and fastened mechanically. Labels shall include the tested assembly/system number, fire rating of the adjacent building element/ firestopping, the firestopping installer and certification, date of installation, and specific instructions to "Do Not Disturb" and "Alert Building Personnel of Damage."
 - 1. Coordinate with Division 09 "Painting" for stenciled painted labeling of fire-rated walls and partitions.
- C. Installer Qualifications: Company specializing in performing the work of this section and trained/certified by firestopping manufacturer.

1.04 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.
- B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Firestopping Manufacturers:
 - 1. 3M Fire Protection Products.
 - 2. A/D Fire Protection Systems Inc.
 - 3. Hilti, Inc.
 - 4. RectorSeal, a CSW Industrials Company.
 - 5. Specified Technologies Inc.
 - 6. Tremco Commercial Sealants & Waterproofing.
 - 7. Substitutions: See Section 016000 - Product Requirements.

2.02 MATERIALS

- A. Mold and Mildew Resistance: Provide firestopping materials with mold and mildew resistance rating of zero (0) in accordance with ASTM G21.
- B. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.
- C. Low-Emitting Materials:
 - 1. Paints and Coatings: Paints and coatings field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with CAL (CDPH SM) AND shall meet applicable VOC limits of CARB (SCM) or SCAQMD 1113.
 - 2. Adhesives and Sealants: Adhesives and sealants field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with CAL (CDPH SM) AND shall meet the chemical content requirements of SCAQMD 1168.

2.03 FIRESTOPPING ASSEMBLY REQUIREMENTS

- A. Perimeter Fire Containment Firestopping: Use system that has been tested according to ASTM E2307 to have fire resistance F Rating equal to required fire rating of floor assembly.
 - 1. Temperature Rise: Provide systems that have been tested to show T Rating as indicated, but not less than 1 hour.
- B. Head-of-Wall (HW) Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of wall assembly.
- C. Floor-to-Floor (FF), Floor-to-Wall (FW), Head-of-Wall (HW), and Wall-to-Wall (WW) Joints, Except Perimeter, Where Both Are Fire-Rated: Use system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.
- D. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.

1. Air Leakage (Smoke Barriers): Provide systems that have been tested to show L Rating of no more than 5.0 cfm/sq. ft., both at ambient and elevated 400 deg F temperatures.

2.04 FIRESTOPPING SYSTEMS

- A. Firestopping: Any material meeting requirements.
 1. Fire Ratings: Use system that is listed by FM (AG), ITS (DIR), or UL (FRD) and tested in accordance with ASTM E814, ASTM E119, or UL 1479 with F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and in compliance with other specified requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.
- C. Install backing materials to prevent liquid material from leakage.

3.03 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by authorities having jurisdiction.
- C. Install labeling required by code.
 1. Coordinate with Division 09 Painting contractor to ensure that all fire-rated walls and partitions are properly labeled.

3.04 CLEANING

- A. Clean adjacent surfaces of firestopping materials.

3.05 PROTECTION

- A. Protect adjacent surfaces from damage by material installation.

END OF SECTION 078400

**SECTION 079200
JOINT SEALANTS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer.
- B. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.
- C. ASTM C834 - Standard Specification for Latex Sealants.
- D. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
- E. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications.
- F. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
- G. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems.
- H. ASTM C1193 - Standard Guide for Use of Joint Sealants.
- I. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants.
- J. ASTM C1311 - Standard Specification for Solvent Release Sealants.
- K. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints.
- L. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.
- M. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board.
- N. SCAQMD 1113 - Architectural Coatings.

1.02 SUBMITTALS

- A. Product Data: Submit manufacturer's technical datasheets for each product to be used; include the following:
 - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
 - 2. List of backing materials approved for use with the specific product.
 - 3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
 - 4. Substrates the product should not be used on.
- B. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.
- C. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.
- D. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.
- E. Preinstallation Field Adhesion Test Plan: Submit at least two weeks prior to start of installation.

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- F. Preinstallation Field Adhesion Test Reports: Submit filled out Preinstallation Field Adhesion Test Reports log within 10 days after completion of tests; include bagged test samples and photographic records.
- G. Executed warranty.

1.03 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section, and is approved and/or certified by manufacturer.
- B. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
 - 1. Adhesion Testing: In accordance with ASTM C794.
 - 2. Compatibility Testing: In accordance with ASTM C1087.
 - 3. Allow sufficient time for testing to avoid delaying the work.
 - 4. Deliver sufficient samples to manufacturer for testing.
 - 5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
- C. Preinstallation Field Adhesion Test Plan: Include destructive field adhesion testing of one sample of each combination of sealant type and substrate, except interior acrylic latex sealants, and include the following for each tested sample.
 - 1. Identification of testing agency.
 - 2. Preinstallation Field Adhesion Test Log Form: Include the following data fields, with known information filled out.
 - a. Test date.
 - b. Copy of test method documents.
 - c. Age of sealant upon date of testing.
 - d. Test results, modeled after the sample form in the test method document.
 - e. Indicate use of photographic record of test.
- D. Field Adhesion Test Procedures:
 - 1. Allow sealants to fully cure as recommended by manufacturer before testing.
 - 2. Have a copy of the test method document available during tests.
 - 3. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
 - 4. When performing destructive tests, also inspect the opened joint for proper installation characteristics recommended by manufacturer, and report any deficiencies.
 - 5. Deliver the samples removed during destructive tests in separate sealed plastic bags, identified with project, location, test date, and test results, to Owner.
 - 6. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.
- E. Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Destructive Tail Procedure.
 - 1. Sample: At least 18 inches long.
 - 2. Minimum Elongation Without Adhesive Failure: Consider the tail at rest, not under any elongation stress; multiply the stated movement capability of the sealant in percent by two; then multiply 1 inch by that percentage; if adhesion failure occurs before the 1-inch mark is that distance from the substrate, the test has failed.

3. If either adhesive or cohesive failure occurs before minimum elongation, take necessary measures to correct conditions and retest; record each modification to products or installation procedures.

1.04 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 5-year manufacturer warranty for installed sealants and accessories that fail to achieve a watertight seal, exhibit loss of adhesion or cohesion, or do not cure. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 JOINT SEALANT APPLICATIONS

- A. Scope:
 1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to:
 - a. Wall expansion and control joints.
 - b. Joints between door, window, and other frames and adjacent construction.
 - c. Joints between different exposed materials.
 - d. Openings below ledge angles in masonry.
 - e. Other joints indicated below.
 2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
 - a. Joints between door, window, and other frames and adjacent construction.
 - b. Wall and ceiling joints.
 - c. Joints between plumbing fixtures and floor or wall construction.
 - d. Other joints indicated below.
 3. Do not seal the following types of joints:
 - a. Intentional weep holes in masonry.
 - b. Joints indicated to be treated with manufactured expansion joint cover, or some other type of sealing device.
 - c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
 - d. Joints where installation of sealant is specified in another section.
- B. Exterior Joints: Use non-sag non-staining silicone sealant (ES-1), unless otherwise indicated.
 1. Type ES-5 - Control and Expansion Joints in Concrete Paving: Self-leveling polyurethane "traffic-grade" sealant.
 2. Type ES-1 or ES-2 - Joints between walls and frames of doors, windows, and louvers.
 3. Type SRS-1 - Bedding joints.
- C. Interior Joints: Use non-sag polyurethane sealant (ES-4), unless otherwise indicated.
 1. Type ES-3 - Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.
 2. Type ES-5 - Floor Joints: Self-leveling polyurethane "traffic-grade" sealant.
 3. Type AS-1 - Joints at sound-rated or acoustic assemblies, and at full-height panel wall and partition assemblies indicated to have sound attenuation batts.

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4. Type LS-1 - Joints around perimeters of interior doors, windows, elevator entrances, and similar framed openings.
- D. Interior Wet Areas: Bathrooms, restrooms, and kitchens; fixtures in wet areas include plumbing fixtures, countertops, cabinets, and other similar items.
- E. Sound-Rated Assemblies: Walls and ceilings identified as STC-rated, sound-rated, or acoustical.
- F. Areas Where Tamper- or Pick-Resistance is Required: Within the secure area designated on the Drawings, and as follows:
 1. Security Sealants shall be used at all construction joints in areas indicated as I-3 Use Group areas, including but not limited to detainee holding and transport areas. Joints above ceilings, covered by expansion joints, or otherwise concealed are excluded.
 2. Provide "tamper-resistant" security sealants for supervised areas (corridors, interview rooms, etc.) and "pick-resistant" security sealants for areas not subject to continuous supervision (cells, holding cells, sleeping rooms, etc). Do not use pick-resistant epoxy in building joints such as control or expansion joints; use tamper-resistant polyurethane at these locations.
 - a. Provide tamper resistant polyurethane for all exposed voids between finish materials, and between finish materials and surface mounted devices that inmates could use to hide contraband in inmate-accessible rooms inside the secure perimeter. Provide also at flooring terminations to walls where no base is scheduled (or painted base only), and at joints between ceilings and walls.
 - b. In prisoner cells and holding cells, provide pick-resistant epoxy at all perimeter joints of all permanent materials and objects (i.e. security ceilings, floors, concrete bed, security hollow metal frames, air grilles, wall embed plates), and provide tamper-resistant polyurethane at all perimeter joints of removable objects (i.e. surface mounted toilet fixtures, emergency intercom, security speaker, exposed wiring devices such as cover plates and receptacles).
 3. Refer to Detention and Security Control Systems/Access Control specifications (Divisions 11 and 28) for additional references and requirements for security sealants.

2.02 JOINT SEALANTS - GENERAL

- A. Low-Emitting Materials:
 1. Paints and Coatings: Paints and coatings field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with CAL (CDPH SM) AND shall meet applicable VOC limits of CARB (SCM) or SCAQMD 1113.
 2. Adhesives and Sealants: Adhesives and sealants field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with CAL (CDPH SM) AND shall meet the chemical content requirements of SCAQMD 1168.

2.03 NONSAG JOINT SEALANTS

- A. Type ES-1 - Low-Modulus Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
 1. Movement Capability: Plus and minus 50 percent, minimum.
 2. Nonstaining to Porous Stone: Nonstaining to light-colored natural stone when tested in accordance with ASTM C1248.
 3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
 4. Color: To be selected by Architect from manufacturer's full range.
 5. Products:

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- a. Master Builders Solutions; MasterSeal NP 100.
 - b. Momentive Performance Materials, Inc/GE Silicones; SCS 2000 SilPruf.
 - c. Pecora Corporation; Pecora 890 NST (Non-Staining Technology) or 890 FST (Field Tint).
 - d. Polymeric Systems, Inc.; PSI-641.
 - e. Tremco Commercial Sealants & Waterproofing; Spectrem 3 or Spectrem 4-TS (Field Tint).
 - f. Substitutions: See Section 016000 - Product Requirements.
- B. Type ES-2 - Medium-Modulus Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
- 1. Movement Capability: Plus and minus 50 percent, minimum.
 - 2. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.
 - 3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
 - 4. Color: To be selected by Architect from manufacturer's full range.
 - 5. Manufacturers:
 - a. Dow Chemical Company; DOWSIL 795 Silicone Building Sealant.
 - b. Momentive Performance Materials, Inc/GE Silicones; SCS9000 SilPruf NB - Non-Staining Silicone Weatherproofing Sealant.
 - c. Pecora Corporation; Pecora 895 NST (Non-Staining Technology).
 - d. Tremco Commercial Sealants & Waterproofing; Spectrem 2.
 - e. Substitutions: See Section 016000 - Product Requirements.
- C. Type ES-3 - Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic. Neutral- or acid-curing per manufacturer standard.
- 1. Color: White.
 - 2. Products:
 - a. Dow; DOWSIL 786 Mildew Resistant.
 - b. Pecora Corporation; Pecora 898 NST (Non-Staining Technology).
 - c. Tremco Commercial Sealants & Waterproofing; Tremsil 600 or Tremsil 200.
 - d. Substitutions: See Section 016000 - Product Requirements.
- D. Type ES-4 - Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; multi-component; not expected to withstand continuous water immersion or traffic.
- 1. Movement Capability: Plus and minus 25 percent, minimum.
 - 2. Color: To be selected by Architect from manufacturer's full range.
 - 3. Products:
 - a. ITW Polymers Sealants; Permathane SM 7200.
 - b. Master Builders Solutions by BASF; MasterSeal NP2.
 - c. Pecora Corporation; DynaTrol II.
 - d. Sika Corporation; Sikaflex-2c NS.
 - e. Tremco Commercial Sealants & Waterproofing; Dymeric 240 FC or Vulkem 227.
 - f. Substitutions: See Section 016000 - Product Requirements.
- E. Security Sealant - "Tamper-Resistant" Polyurethane Sealant: ASTM C920, Grade NS, Uses M, G, and A; single or multi-component; not expected to withstand continuous water immersion or traffic.

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1. Movement Capability: Plus and minus 12-1/2 percent, minimum.
 2. Hardness Range: 50 to 60, Shore A, when tested in accordance with ASTM C661.
 3. Products:
 - a. Master Builders Solutions; MasterSeal CR 195.
 - b. Pecora Corporation; DynaFlex SC.
 - c. Sika Corp; Sikaflex 11 FC.
- F. Security Sealant - "Pick-Resistant" Epoxy Sealant: ASTM C881/C881M, Type I and III, Grade 3, Class B and C; two-component.
1. Hardness Range: 65 to 75, Shore D, when tested in accordance with ASTM C661.
 2. Products:
 - a. Euclid Chemical; Dural 452 Gel.
 - b. Pecora Corporation; DynaPoxy EP-1200 Two-Part Epoxy Security Sealant.
 - c. Sika Corp; Sikadur 23.
 - d. Substitutions: See Section 016000 - Product Requirements.
- G. Type LS-1 - Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.
1. Color: To be selected by Architect from manufacturer's full range.
 2. Grade: ASTM C834; Grade NF.
 3. Products:
 - a. Bostik, Inc; Chem-Calk 600.
 - b. ITW Polymers Sealants; SM 8200.
 - c. Master Builders Solutions; MasterSeal NP 520.
 - d. Pecora Corporation; AC-20 +Silicone.
 - e. Tremco Commercial Sealants & Waterproofing; Tremflex 834.
 - f. Substitutions: See Section 016000 - Product Requirements.
- H. Type AS-1 - Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging acoustical sealant.
1. Color: Standard colors matching finished surfaces, Type OP (opaque).
 2. Grade: ASTM C834; Grade NF.
 3. Manufacturers:
 - a. Accumetric LLC; BOSS 826 Acoustical Sound Sealant.
 - b. Franklin International, Inc; Titebond GREENchoice Acoustical Smoke & Sound Sealant.
 - c. Hilti, Inc; CP 506 Smoke and Acoustical Sealant.
 - d. Master Builders Solutions; MasterSeal NP 520.
 - e. Momentive Performance Materials, Inc/GE Silicones; RCS20 Acoustical.
 - f. Pecora Corporation; AC-20 FTR or AIS-919.
 - g. Specified Technologies Inc; Smoke N' Sound Acoustical Sealant.
 - h. Tremco Commercial Sealants & Waterproofing; Tremstop Smoke and Sound.
 - i. Substitutions: See Section 016000 - Product Requirements.
- I. Type SRS-1 - Butyl Sealant: Solvent-based; ASTM C1311; single component, nonsag; not expected to withstand continuous water immersion or traffic.
1. Products:
 - a. Bostik, Inc; Chem-Calk 300.

- b. Pecora Corporation; Pecora BC-158 Butyl Rubber Sealant.
- c. Tremco Inc.; Tremco Butyl Sealant.
- d. Substitutions: See Section 016000 - Product Requirements.

2.04 SELF-LEVELING JOINT SEALANTS

- A. Type ES-5 - Self-Leveling Polyurethane Sealant for Traffic: Polyurethane; ASTM C920, Grade P, Uses T, M and A; single or multi-component; explicitly approved by manufacturer for traffic exposure.
 - 1. Movement Capability: Plus and minus 25 percent, minimum.
 - 2. Products:
 - a. Bostik, Inc.; Chem-Calk 550.
 - b. Pacific Polymers, Inc; Elast-Thane 227 Type 1 (Self-Leveling).
 - c. Pecora Corporation; Dynatrol II-SL.
 - d. Polymeric Systems, Inc; PSI-270SL.
 - e. Tremco Commercial Sealants & Waterproofing; Vulkem 45SSL or 445SSL.
 - f. W. R. MEADOWS, Inc; POURTHANE SL.
 - g. Substitutions: See Section 016000 - Product Requirements.

2.05 ACCESSORIES

- A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
- B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.
- C. Masking Tape: Self-adhesive, nonabsorbent, nonstaining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.
- D. Joint Cleaner: Noncorrosive and nonstaining type, type recommended by sealant manufacturer; compatible with joint forming materials.
- E. Primers: Type recommended by sealant manufacturer to suit application; nonstaining.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.
- C. Verify that backer rods are of the correct size.
- D. Preinstallation Adhesion Testing: Install a sample for each test location indicated in the test plan.
 - 1. Test each sample as specified in PART 1 under QUALITY ASSURANCE article.
 - 2. Notify Architect of date and time that tests will be performed, at least seven days in advance.
 - 3. Record each test on Preinstallation Adhesion Test Log as indicated.
 - 4. If any sample fails, review products and installation procedures, consult manufacturer, or take other measures that are necessary to ensure adhesion; retest in a different location; if unable to obtain satisfactory adhesion, report to Architect.

5. After completion of tests, remove remaining sample material and prepare joints for new sealant installation.

3.02 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.
- E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in an inconspicuous area to verify that it does not stain or discolor slab.

3.03 INSTALLATION

- A. Install this work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Provide joint sealant installations complying with ASTM C1193.
- C. Install acoustical sealant application work in accordance with ASTM C919.
- D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- E. Install bond breaker backing tape where backer rod cannot be used.
- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- H. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.
- I. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.
- J. Installation of Security Sealants: Install in locations indicated in accordance with manufacturer's written recommendations.
 1. Apply pick-resistant non-flexible 95 shore "A" hardness epoxy type security sealant in all spaces and cracks between similar and dissimilar materials including, but not limited to, metal frames, windows, all fixtures except vitreous china plumbing fixtures, detention furniture, embeds, secure air diffusers, lock columns and receivers.
 2. Apply tamper resistant flexible 55 shore "A" hardness security sealant in any open joints located in cells, including joints at the intersections of walls to walls, walls to ceilings and walls to floors.

3.04 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements for additional requirements.
- B. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.
- C. Destructive Adhesion Testing: If there are any failures in first 1,000 linear feet, notify Architect immediately.

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- D. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.
- E. Repair destructive test location damage immediately after evaluation and recording of results.

END OF SECTION 079200

SECTION 081113
STEEL DOORS AND FRAMES

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100).
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- C. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames.
- D. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames.

1.02 SUBMITTALS

- A. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes.
- B. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
- C. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Hollow Metal Doors and Frames:
 - 1. Ceco Door, an Assa Abloy Group company.
 - 2. Curries, an Assa Abloy Group company.
 - 3. Fleming Door Products, an Assa Abloy Group company.
 - 4. Krieger Specialty Products.
 - 5. Mesker, dormakaba Group.
 - 6. Metal Products, Inc. (MPI)
 - 7. Pioneer Industries, Inc.; an Assa Abloy Group company.
 - 8. Republic Doors, an Allegion brand.
 - 9. Steelcraft, an Allegion brand.
 - 10. Technical Glass Products.

2.02 PERFORMANCE REQUIREMENTS

- A. Requirements for Hollow Metal Doors and Frames:
 - 1. Steel Sheet: Comply with one or more of the following requirements; galvanized steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.

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2. Accessibility: Comply with ICC A117.1 and ADA Standards.
 3. Door Top and Bottom Closures: Flush end closure channel, with top and door faces aligned.
 - a. Inverted channel closure is acceptable for bottom edges and top edges of interior doors that are not exposed to view from above.
 4. Door Edge Profile: Beveled edge.
 5. Typical Door Face Sheets: Flush.
 6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturer's standard.
 7. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
 8. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
 - a. Based on SDI Standards: Provide at least A40/ZF120 (galvannealed) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvannealed) for corrosive locations.
- B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

- A. Door Finish: Factory primed and field finished.
- B. Exterior Doors: Thermally insulated. Fabricate from metallic-coated steel sheet.
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 3 - Extra Heavy-duty.
 - b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 2 - Seamless.
 - d. Door Face Metal Thickness: 16 gauge, 0.053 inch, minimum.
 - e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
 2. Door Core Material: Vertical steel stiffeners with fiberglass batts.
 - a. Foam Plastic Insulation: Manufacturer's standard board insulation with maximum flame spread index (FSI) of 75, and maximum smoke developed index (SDI) of 450 in accordance with ASTM E84, and completely enclosed within interior of door.
 3. Door Thermal Resistance: R-Value of 6, minimum.
 4. Door Thickness: 1-3/4 inches, nominal.
 5. Weatherstripping: Refer to Division 08 "Door Hardware".
- C. Interior Doors, Non-Fire-Rated: Fabricate from either cold-rolled steel sheet or metallic-coated steel sheet.
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 2 - Heavy-duty.
 - b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.

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- c. Model 1 - Full Flush.
 - d. Door Face Metal Thickness: 18 gauge, 0.042 inch, minimum.
- 2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements, except kraft paper honeycomb core is not acceptable.
- 3. Door Thickness: 1-3/4 inches, nominal.
- D. Fire-Rated Doors: Comply with NFPA 80.
 - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Match construction and physical performance levels above for interior or exterior doors, as applicable.
 - 2. Fire Rating: As indicated, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
 - 3. Per NFPA 80, fire exit doors shall be labeled "Fire Door to Be Equipped with Fire Exit Hardware," and shall be reinforced and constructed to maintain the rating of the specific listed and labeled fire exit devices mounted on them.
 - 4. Provide units listed and labeled by UL (DIR) or ITS (DIR).
 - a. Attach fire rating label to each fire rated unit.
 - 5. Door Core Material: Manufacturers standard core material/construction in compliance with requirements.
 - 6. Door Thickness: 1-3/4 inches, nominal.

2.04 HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
- B. Frame Finish: Factory primed and field finished.
- C. Exterior Door Frames: Face welded type.
 - 1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A40/ZF120 coating.
 - 2. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.
 - 3. Weatherstripping: Refer to Division 08 Section "Door Hardware".
- D. Interior Door Frames, Non-Fire Rated: Face welded type.
 - 1. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.
- E. Door Frames, Fire-Rated: Face welded type.
 - 1. Fire Rating: Same as door, labeled.
 - 2. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.
- F. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.
- G. Mullions for Pairs of Doors: Fixed, except where removable is indicated, with profile similar to jambs.
 - 1. Where removable mullion is indicated, coordinate with removable mullion to be provided as an exit device accessory per Division 08 Section "Door Hardware."
- H. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.
- I. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.

- J. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches high to fill opening without cutting masonry units.
- K. Frames Wider than 48 inches: Reinforce with steel channel fitted tightly into frame head, flush with top.

2.05 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.06 ACCESSORIES

- A. Louvers: Roll formed steel with overlapping frame; finish same as door components; factory-installed.
 - 1. In Fire-Rated Doors: UL (DIR) or ITS (DIR) listed fusible link louver, same rating as door.
 - 2. Style: Sightproof inverted V- or Y-blade.
 - 3. Fasteners: Exposed or concealed fasteners.
- B. Glazing: As specified in Section 088000.
- C. Removable and Fixed Stops: Formed sheet steel, mitered or butted corners; prepared for countersink style tamper proof screws.
 - 1. Provide fixed stops for exterior applications, and toward the secure side of interior glazed lites (for example, toward the corridor or more public accessible spaces).
 - 2. Heights of Stops: Unless otherwise indicated or recommended by glazing manufacturer, provide standard 5/8-inch height stops where allowed by standards, and provide 3/4-inch height for exterior 1-inch glazing units.
- D. Astragals and Edges for Double Doors: Pairs of door astragals, and door edge sealing and protection devices.
 - 1. Provide UL listed products, complying with NFPA 80, and as required to maintain indicated fire rating.
 - 2. Provide surface mounted overlapping-type astragal to cover or fill space for full door height between pair of doors or door and adjacent jamb.
- E. Mechanical Fasteners for Concealed Metal-to-Metal Connections: Self-drilling, self-tapping, steel with electroplated zinc finish.
- F. Grout for Frames: Mortar grout complying with ASTM C476 with maximum slump of 4 inches as measured in accordance with ASTM C143/C143M for hand troweling in place; plaster grout and thinner pumpable grout are prohibited.
- G. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
- H. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 INSTALLATION

- A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
 - 1. Install in accordance with ANSI/SDI A250.11.
 - 2. Do not remove temporary frame spreaders until after frames have been properly set and secured.
- B. Install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.
- D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
- E. Install door hardware as specified in Section 087100.
- F. Comply with glazing installation requirements of Section 088000.
- G. Coordinate installation of electrical connections to electrical hardware items.
- H. Touch up damaged factory finishes.

3.03 TOLERANCES

- A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.
 - 1. Comply with clearances indicated in NFPA 80 for fire-rated doors.
- B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.04 ADJUSTING

- A. Adjust for smooth and balanced door movement.

END OF SECTION 081113

**SECTION 083100
ACCESS DOORS AND PANELS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ITS (DIR) - Directory of Listed Products.
- B. UL (FRD) - Fire Resistance Directory.

1.02 SUBMITTALS

- A. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
- B. Shop Drawings: Indicate exact position of each access door and/or panel unit.
 - 1. Include a schedule indicating wall/ceiling type, door types, sizes, and hardware for each access door required.

1.03 COORDINATION

- A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, or other concealed work, and indicate in the schedule specified in "Submittals" Article.
 - 1. This (083100) material specification includes access doors required for Divisions 21 (Fire Suppression), Division 22, (Plumbing), 23 (HVAC) and Division 26 (Electrical) work and any other access doors indicated on Drawings.

PART 2 PRODUCTS

2.01 WALL- AND CEILING-MOUNTED ACCESS UNITS

- A. Manufacturers:
 - 1. Activar Construction Products Group, Inc. - JL Industries.
 - 2. ACUDOR Products Inc.
 - 3. Babcock-Davis.
 - 4. Best Access Doors.
 - 5. Cendrex, Inc.
 - 6. Karp Associates, Inc.
 - 7. Larsen's Manufacturing Company.
 - 8. Milcor, Inc.
 - 9. Nystrom, Inc.
 - 10. Williams Brothers Corporation of America.
 - 11. Substitutions: See Section 016000 - Product Requirements.
- B. Wall- and Ceiling-Mounted Units (Interior): Factory-fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.
 - 1. Material: Steel.
 - 2. Style (Gypsum Board locations): Recessed door panel for infill with wall/ceiling finish.
 - a. Gypsum Board Mounting Criteria: Use drywall bead type frame.
 - 3. Style (Masonry locations): Exposed frame, with door surface flush with frame surface.

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4. Door Style: Double-skinned hollow panel.
 5. Frames: 16-gauge, 0.0598-inch minimum thickness.
 6. Double-Skinned Hollow Steel Sheet Door Panels: 16-gauge, 0.059-inch minimum thickness, on both sides and along each edge.
 7. Units in Fire-Rated Assemblies: Fire rating as required by applicable code for fire-rated assembly that access doors are being installed.
 - a. Provide products listed by ITS (DIR) or UL (FRD) as suitable for purpose indicated.
 - b. Provide certificate of compliance from authorities having jurisdiction indicating approval of fire rated doors.
 - c. Fire-rated door assemblies shall conform with and be installed in accordance with (1) NFPA 80, (2) door and frame manufacturer's installation instructions, and (3) listing requirements of qualified testing agency.
 - d. Provide manufacturer's standard mineral fiber insulation and gasketing.
 8. Steel Finish: Factory-primed; for field topcoat to match that used for hollow metal steel doors and frames. Refer to Division 9 Painting for topcoat information.
 9. Hardware:
 - a. Hardware for Fire-Rated Units: As required for listing.
 - b. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.
 - c. Latch/Lock: Cylinder lock-operated cam latch, two keys for each unit.
- C. Security/Detention Access Doors (Interior): Factory-fabricated door and frame, fully assembled units with all joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit. Provide high-security access doors in areas accessible to residents, and medium-security access doors for areas not accessible to residents.
1. Material: Steel.
 2. Style: Exposed frame, with door surface flush with frame surface.
 3. Access Door Sizes: As indicated on the Drawings.
 4. Frames: As indicated below for high-security or medium-security.
 5. Doors: Single thickness steel plate with steel angle frame/stop.
 6. Steel Finish: Factory-primed; for field topcoat to match that used for hollow metal steel doors and frames. Refer to Division 9 Painting for topcoat information.
 7. High-Security Access Doors:
 - a. Frames: Fabricate of minimum 2-inch by 2-inch by 3/16-inch steel angle.
 - b. Doors: Fabricate of 10-gauge, 0.135-inch minimum thickness sheet steel.
 - c. Hardware:
 - 1) Hinges: Provide heavy duty steel butt hinges welded to door and frame.
 - 2) Latch/Lock: Provide access doors prepped for detention deadlock with security type key cylinder by same manufacturer as approved security door hardware (Division 11). Coordinate with security door hardware supplier. Key all secure access doors alike, coordinate with Security Hardware masterkeying.
 8. Medium-Security Access Doors:
 - a. Frames: Fabricate of 12-gauge, 0.105-inch minimum thickness sheet steel, with 1-inch exposed flange.
 - b. Doors: Fabricate of 12-gauge, 0.105-inch minimum thickness sheet steel.
 - c. Hardware:
 - 1) Hinges: Provide concealed piano hinge.

- 2) Latch/Lock: Provide manufacturer's standard mortise-type lock. Coordinate with Division 8 Door Hardware for cylinders and facility keying. Key all access door locks alike.
- 9. Fasteners/Anchors: Provide hot-dip galvanized anchors of type recommended by manufacturer for indicated substrate. Fasteners at all security access doors shall be tamper resistant.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that rough openings are correctly sized and located.
- B. Begin installation only after substrates have been properly prepared, and if the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to proceeding with this work.
- B. Prepare surfaces using methods recommended by manufacturer for applicable substrates in accordance with project conditions.

3.03 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings, and secure units rigidly in place.
- C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION 083100

**SECTION 087100
DOOR HARDWARE**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design.
- B. BHMA (CPD) - Certified Products Directory.
- C. BHMA A156.1 - Standard for Butts and Hinges.
- D. BHMA A156.3 - Exit Devices.
- E. BHMA A156.4 - Door Closers and Pivots.
- F. BHMA A156.6 - Standard for Architectural Door Trim.
- G. BHMA A156.7 - Template Hinge Dimensions.
- H. BHMA A156.8 - Door Controls - Overhead Stops and Holders.
- I. BHMA A156.13 - Mortise Locks & Latches Series 1000.
- J. BHMA A156.16 - Standard for Auxiliary Hardware.
- K. DHI (H&S) - Sequence and Format for the Hardware Schedule.
- L. ICC A117.1 - Accessible and Usable Buildings and Facilities.
- M. ITS (DIR) - Directory of Listed Products.
- N. NFPA 70 - National Electrical Code.
- O. NFPA 80 - Standard for Fire Doors and Other Opening Protectives.
- P. NFPA 101 - Life Safety Code.
- Q. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.
- R. UL (DIR) - Online Certifications Directory.
- S. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate all door hardware products and keying requirements with existing facility standards and with Owner prior to furnishing.
- B. Coordinate with Division 11 "Security Hardware" for detention hardware for products within the secure perimeter.
- C. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.
- D. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.
- E. Preinstallation Meeting: Convene a preinstallation meeting one week prior to commencing work of this section; attendance is required by affected installers and the following:
 - 1. Architect.
 - 2. Installer's Architectural Hardware Consultant (AHC).
 - 3. Hardware Installer.
 - 4. Owner's Security Consultant.

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- F. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.
- G. Keying Requirements Meeting:
 - 1. Attendance Required:
 - a. Contractor.
 - b. Owner.
 - c. Architect.
 - d. Installer's Architectural Hardware Consultant (AHC).
 - 2. Agenda:
 - a. Establish keying requirements. Confirm Owner's facility standards.
 - b. Verify locksets and locking hardware are functionally correct for project requirements.
 - c. Verify that keying and programming complies with project requirements.
 - d. Establish keying submittal schedule and update requirements.
 - 3. Incorporate "Keying Requirements Meeting" decisions into keying submittal upon review of door hardware keying system including, but not limited to, the following:
 - a. Access control requirements.
 - b. Key control system requirements.
 - 4. Record minutes and distribute digital PDF copies within two days after meeting to participants, with copies to Architect, Owner, participants, and those affected by decisions made.
 - 5. Deliver established keying requirements to manufacturers.

1.03 SUBMITTALS

- A. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.
- B. Shop Drawings - Door Hardware Schedule: Submit detailed listing that includes each item of hardware to be installed on each door. Use door numbering scheme as included in Contract Documents.
 - 1. Prepared by or under supervision of Architectural Hardware Consultant (AHC).
 - 2. Comply with DHI (H&S) using door numbers and hardware set numbers as indicated in construction documents.
 - 3. List groups and suffixes in proper sequence.
 - 4. Provide complete description for each door listed.
 - 5. Provide manufacturer name, product names, and catalog numbers; include functions, types, styles, sizes and finishes of each item.
 - 6. Where electrified hardware is indicated, submit diagrams for power, signal, and control wiring that include details of interface with building safety and security systems. Include an operations narrative describing how opening operates from either side at any given time.
- C. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.
- D. Keying Schedule:
 - 1. Submit Keying Schedule in digital format, in compliance with requirements established during Keying Requirements Meeting, unless otherwise indicated.
- E. Maintenance Materials and Tools: Furnish the following for Owner's use in maintenance of project.

1. See Section 016000 - Product Requirements, for additional provisions.
2. Lock Cylinders: Ten for each master keyed group.
3. Tools: One set of each special wrench or tool applicable for each different or special hardware component, whether supplied by hardware component manufacturer or not.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified for commercial/institutional door hardware, with experience in work of similar size and scope.
- B. Supplier Qualifications: Company with Door and Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) to assist in work of this section, and with experience in commercial/institutional work of similar size and scope.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.

1.06 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer's Warranty: Provide warranty against defects in material and workmanship for period indicated. Complete forms in Owner's name and register with manufacturer.
 1. Closers: Ten years, minimum.
 2. Other Hardware: Two years, minimum.

PART 2 PRODUCTS

2.01 MANUFACTURERS AND PRODUCTS

- A. Scheduled Door Hardware: Provide door hardware in compliance with this section and with the door hardware sets in the Door Hardware Schedule located at the end of this specification section.
- B. Designations: Requirements for the design, function, grade, finish, size, and other characteristics for each item of door hardware are included in the Door Hardware Schedule located at the end of this specification section.
 1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type in the Door Hardware Schedule, for the purpose of establishing minimum requirements for that piece of hardware. Products that are equivalent in function, quality, size, finish, and other indicated criteria may be submitted, subject to approval by Architect.

2.02 DESIGN AND PERFORMANCE CRITERIA

- A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.
- B. Provide individual items of single type, of same model, and by same manufacturer.
- C. Provide door hardware products that comply with the following requirements:
 1. Applicable provisions of federal, state, and local codes.
 2. Accessibility: ADA Standards and ICC A117.1.
 3. Applicable provisions of NFPA 101.

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4. Fire-Rated Doors: NFPA 80, listed and labeled by qualified testing agency for fire protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
 5. Hardware on Fire-Rated Doors: Listed and classified by UL (DIR), ITS (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for application indicated.
 6. Listed and certified compliant with specified standards by BHMA (CPD).
 7. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified.
- D. Electrically Operated and/or Controlled Hardware: Provide necessary power supplies, power transfer hinges, relays, and interfaces as required for proper operation; provide wiring between hardware and control components and to building power connection in compliance with NFPA 70.
1. See Division 28 for additional access control system requirements.
- E. Lock Function: Provide lock and latch function numbers and descriptions of manufacturer's series. See Door Hardware Schedule.
- F. Fasteners:
1. Provide fasteners of proper type, size, quantity, and finish that comply with commercially recognized standards for proposed applications.
 - a. Aluminum fasteners are not permitted.
 - b. Provide phillips flat-head screws with heads finished to match door surface hardware unless otherwise indicated.
 2. Fire-Rated Applications: Comply with NFPA 80.
 - a. Provide wood or machine screws for hinges mortised to doors or frames, strike plates to frames, and closers to doors and frames.
 - b. Provide steel through bolts for attachment of surface mounted closers, hinges, or exit devices to door panels unless proper door blocking is provided.

2.03 HINGES

- A. Manufacturers:
1. McKinney; an Assa Abloy Group company.
 2. Hager Companies.
 3. Ives, an Allegion brand.
 4. Stanley, dormakaba Group.
 5. Substitutions: See Section 016000 - Product Requirements.
- B. Hinges: Comply with BHMA A156.1, Grade 1.
1. Butt Hinges: Comply with BHMA A156.1 and BHMA A156.7 for templated hinges.
 - a. Provide hinge width required to clear surrounding trim.
 2. Provide hinges on every swinging door.
 3. Provide five-knuckle full mortise butt hinges unless otherwise indicated.
 4. Provide following quantity of butt hinges for each door:
 - a. Doors up to 60 inches High: Two hinges.
 - b. Doors From 60 inches High up to 90 inches High: Three hinges.
 - c. Doors 90 inches High up to 120 inches High: Four hinges.

2.04 EXIT DEVICES

- A. Manufacturers:
-

1. Corbin Russwin, Sargent, or Yale; an Assa Abloy Group company.
 2. DORMA USA, Inc.
 3. Stanley, dormakaba Group.
 4. Von Duprin, an Allegion brand.
 5. Substitutions: See Section 016000 - Product Requirements.
- B. Exit Devices: Comply with BHMA A156.3, Grade 1.
1. Lever design to match lockset trim.
 2. Provide cylinder with cylinder dogging or locking trim.
 3. Provide exit devices properly sized for door width and height.
 4. Provide strike as recommended by manufacturer for application indicated.
 5. Provide UL (DIR) listed exit device assemblies for fire-rated doors and panic device assemblies for non-fire-rated doors.

2.05 LOCK CYLINDERS

- A. Lock Cylinders: Provide key access on outside of each lock, unless otherwise indicated.
1. Provide cylinders from same manufacturer as locking device.
 2. Provide cams and/or tailpieces as required for locking devices.

2.06 MORTISE LOCKS

- A. Manufacturers:
1. Corbin Russwin, Sargent, or Yale; an Assa Abloy Group company.
 2. Best, dormakaba Group.
 3. DORMA USA, Inc.
 4. Schlage, an Allegion brand.
 5. Substitutions: See Section 016000 - Product Requirements.
- B. Mortise Locks: Comply with BHMA A156.13, Grade 1, Security, 1000 Series.
1. Latchbolt Throw: 3/4 inch, minimum.
 2. Deadbolt Throw: 1 inch, minimum.
 3. Backset: 2-3/4 inch unless otherwise indicated.
 4. Strikes: Provide manufacturer's standard strike for each latchset or lockset with strike box and curved lip extending to protect frame in compliance with indicated requirements.
 - a. Finish: To match lock or latch.

2.07 DOOR PULLS AND PUSH PLATES

- A. Manufacturers:
1. Rockwood; an Assa Abloy Group company.
 2. Ives, an Allegion brand.
 3. Trimco.
 4. Substitutions: See Section 016000 - Product Requirements.
- B. Door Pulls and Push Plates: Comply with BHMA A156.6.
1. Pull Type: Straight, unless otherwise indicated.
 2. Push Plate Type: Flat, with square corners, unless otherwise indicated.
 - a. Edges: Beveled, unless otherwise indicated.
 3. Material: Aluminum, unless otherwise indicated.

2.08 DOOR PULLS AND PUSH BARS

- A. Manufacturers:
 - 1. Rockwood; an Assa Abloy Group company.
 - 2. Ives, an Allegion brand.
 - 3. Trimco.
- B. Door Pulls and Push Bars: Comply with BHMA A156.6.
 - 1. Bar Type: Bar set, unless otherwise indicated.
 - 2. Material: Aluminum, unless otherwise indicated.

2.09 CLOSERS

- A. Manufacturers; Surface Mounted:
 - 1. Corbin Russwin or Sargent; an Assa Abloy Group company.
 - 2. DORMA USA, Inc; .
 - 3. LCN, an Allegion brand.
 - 4. Stanley, dormakaba Group.
 - 5. Substitutions: See Section 016000 - Product Requirements.
- B. Closers: Comply with BHMA A156.4, Grade 1.
 - 1. Type: Surface mounted to door.
 - 2. Provide door closer on each exterior door.
 - 3. Provide door closer on each fire-rated and smoke-rated door.
 - 4. Where an overlapping astragal is included on pairs of swinging doors, provide coordinator to ensure door leaves close in proper order.

2.10 OVERHEAD STOPS AND HOLDERS

- A. Manufacturers:
 - 1. Rixson or Sargent; an Assa Abloy Group company.
 - 2. DORMA USA, Inc;.
 - 3. Glynn-Johnson, an Allegion brand.
 - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Overhead Stops and Holders (Door Checks): Comply with BHMA A156.8, Grade 1.
 - 1. Provide stop for every swinging door, unless otherwise indicated.

2.11 KICK PLATES

- A. Manufacturers:
 - 1. Rockwood; an Assa Abloy Group company.
 - 2. Ives, an Allegion brand.
 - 3. Trimco.
- B. Kick Plates: Provide along bottom edge of push side of every door with closer, except aluminum storefront and glass entry doors, unless otherwise indicated.
 - 1. Size: 8 inch high by 2 inch less door width (LDW) on push side of door.

2.12 WALL STOPS

- A. Manufacturers:
 - 1. Rockwood; an Assa Abloy Group company.

2. Hager Companies.
 3. Trimco.
 4. Substitutions: See Section 016000 - Product Requirements.
- B. Wall Stops: Comply with BHMA A156.16, Grade 1 and Resilient Material Retention Test as described in this standard.
1. Type: Bumper, concave, wall stop.
 2. Material: Aluminum housing with rubber insert.

2.13 FINISHES

- A. Finishes: Provide door hardware of same finish, unless otherwise indicated. Refer to Door Hardware Schedule at the end of this section.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.
- B. Verify that electric power is available to power operated devices and of correct characteristics.

3.02 INSTALLATION

- A. Preparation: Comply with DHI/ANSI A115 standards for preparation of steel doors and frames and for wood doors.
1. Comply with SDI 107 for surface applied hardware on steel doors.
- B. Install hardware in accordance with manufacturer's instructions and applicable codes.
- C. Install hardware on fire-rated doors and frames in accordance with applicable codes and NFPA 80.
- D. Use templates provided by hardware item manufacturer.
- E. Do not install surface mounted items until application of finishes to substrate are fully completed.
- F. Door Hardware Mounting Heights: Distance from finished floor to center line of hardware item. As indicated in following list; unless noted otherwise in Door Hardware Schedule or on drawings.
1. Mounting heights in compliance with ADA Standards:
 - a. Locksets: 40-5/16 inch.
 - b. Push Plates/Pull Bars: 42 inch.
 - c. Deadlocks (Deadbolts): 48 inch.
 - d. Exit Devices: 40-5/16 inch.
- G. Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.

3.03 FIELD QUALITY CONTROL

- A. Installer's Architectural Hardware Consultant (AHC) shall inspect installation and certify that hardware and installation has been furnished and installed in accordance with manufacturer's instructions and as specified.

3.04 ADJUSTING

- A. Initial Adjustment: Provide initial adjustments on each door hardware item immediately prior to Substantial Completion. Verify that operable components function smoothly and properly.
 - 1. Adjust hinges, closers, automatic door openers, and other operable items to ensure that sweep period and opening force requirements of swing doors comply with ADA standards and with requirements of authority having jurisdiction.
 - 2. Remove and replace hardware that can not be adjusted to function smoothly and properly.
- B. Post-Occupancy Adjustment: Installer's Architectural Hardware Consultant (AHC) shall return approximately six months after Substantial Completion and inspect each door hardware item and provide adjustments as necessary. Remove and replace hardware components that have failed due to defective or deteriorated materials, or due to faulty workmanship or installation.
 - 1. At the Post-Occupancy Adjustment, meet with Owner's designated representative(s) to review recommended maintenance and adjustment procedures. Provide training in the use of special maintenance tools.

3.05 CLEANING

- A. Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.
- B. Clean adjacent surfaces soiled by hardware installation.
- C. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

3.06 PROTECTION

- A. Protect finished Work under provisions of Section 017000 - Execution and Closeout Requirements.
- B. Do not permit adjacent work to damage hardware or finish.

3.07 DOOR HARDWARE SCHEDULE

- A. Refer to Door Hardware Schedule appended to the end of this section.

END OF SECTION 087100

SECTION 087101 – DOOR HARDWARE SCHEDULE

PART 1 - PRODUCTS

1.1 SCHEDULED DOOR HARDWARE

- A. Refer to “PART 3 – EXECUTION” for required specification sections.

PART 2 -

1. MK - McKinney
2. YA - ASSA ABLOY ACCENTRA
3. SA - SARGENT
4. RO - Rockwood
5. RF - Rixson
6. NO - Norton
7. PE - Pemko
8. OT - Other

Hardware Sets

Set: 1.0

Hinge	T4A3786	US26D	MK
1 Exit Device	12 LC 8804 ETJ	US32D	SA
1 Cylinder	AS REQUIRED x MATCH & EXTEND OWNER'S EXISTING KEY SYSTEM	626	
1 Surface Closer	CPS7500	689	NO
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Set Door Seals	S88BL		PE

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Set: 2.0

Hinge	TA2714	US26D	MK
1 Exit Device	LC NB8706 ETJ	US32D	SA
1 Exit Device	NB8710 EO	US32D	SA
1 Cylinder	AS REQUIRED x MATCH & EXTEND OWNER'S EXISTING KEY SYSTEM	626	
2 Surface Closer	CPS7500	689	NO
2 Kick Plate	K1050 8" high CSK	US32D	RO
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

Set: 3.0

Hinge	TA2714	US26D	MK
1 Privacy Lock	CRCN 8802FL V21	630	YA
1 Surface Closer	CPS7500	689	NO
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Set Door Seals	S88BL		PE

Set: 4.0

Hinge	TA2714	US26D	MK
1 Hotel Lock	CRCN 8820FL LC V21	630	YA
1 Cylinder	AS REQUIRED x MATCH & EXTEND OWNER'S EXISTING KEY SYSTEM	626	
1 Surface Closer	CPS7500	689	NO
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

Set: 5.0

Hinge	TA2714	US26D	MK
1 Office Lock	CRCN 8807FL LC	630	YA
1 Cylinder	AS REQUIRED x MATCH & EXTEND OWNER'S EXISTING KEY SYSTEM	626	
1 Overhead Stop	10 SERIES	630	RF
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

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Set: 6.0

Hinge	TA2714	US26D	MK
1 Office Lock	CRCN 8807FL LC	630	YA
1 Cylinder	AS REQUIRED x MATCH & EXTEND OWNER'S EXISTING KEY SYSTEM	626	
1 Surface Closer	CPS7500	689	NO
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

Set: 7.0

Hinge	TA2714	US26D	MK
1 Classroom Lock	CRCN 8808FL LC	630	YA
1 Cylinder	AS REQUIRED x MATCH & EXTEND OWNER'S EXISTING KEY SYSTEM	626	
1 Surface Closer	CPS7500	689	NO
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

Set: 8.0

Hinge, Spring	1502	US26D	MK
1 Exit Lock	CRCN 8833FL LC	630	YA
1 Cylinder	AS REQUIRED x MATCH & EXTEND OWNER'S EXISTING KEY SYSTEM	626	
1 Flush Pull	94L	US32D	RO
1 Overhead Stop	10 SERIES	630	RF
1 Set Door Seals	S88BL		PE

Set: 9.0

2 Exit Device	LC NB8713 ETJ	US32D	SA
2 Cylinder	AS REQUIRED x MATCH & EXTEND OWNER'S EXISTING KEY SYSTEM	626	
2 Surface Closer	PR7500	689	NO
1 Hardware	SEE NOTE BELOW		OT

NOTE: EXISTING DOOR - BALANCE OF EXISTING HARDWARE TO REMAIN AND BE REUSED.

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Set: 10.0

1 Electrified Lock	CRCN 8891FL LC REX	630	YA
1 Cylinder	AS REQUIRED x MATCH & EXTEND OWNER'S EXISTING KEY SYSTEM	626	
1 Hardware	SEE NOTE BELOW		OT

OPERATION: DOOR STATUS TO BE CONTROLLED BY BUILDING'S ACCESS CONTROL SYSTEM.

NOTE: EXISTING DOOR - BALANCE OF EXISTING HARDWARE TO REMAIN AND BE REUSED.

Set: 11.0

Hinge, Spring	1502	US26D	MK
1 Hardware	SEE NOTE BELOW		OT

NOTE: EXISTING DOOR - BALANCE OF EXISTING HARDWARE TO REMAIN AND BE REUSED.

Set: 12.0

1 Hardware	SEE NOTE BELOW		OT

NOTE: EXISTING DOOR - ALL EXISTING HARDWARE TO REMAIN AND BE REUSED.

Set: 13.0

1 Hardware	SEE NJOTE BELOW		OT

NOTE: DETENTION DOOR - ALL HARDWARE FURNISHED IN OTHER SECTION.

END OF SECTION 087100

**SECTION 088733
DECORATIVE FILMS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.02 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Record of product certification for safety requirements.
 - 2. Preparation instructions and recommendations.
 - 3. Storage and handling requirements and recommendations.
 - 4. Installation methods.
- B. Shop Drawings: Detailing installation of film, anchoring accessories, and sealant.
- C. Samples: For each film product to be used, minimum size 4 inches by 6 inches, representing actual product, color, and patterns.
- D. Specimen Warranty.

1.03 QUALITY ASSURANCE

- A. Installer Qualifications: Certified by glazing film manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of authorities having jurisdiction.

1.05 FIELD CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.06 WARRANTY

- A. Provide 10 year manufacturer's replacement warranty to cover film against peeling, cracking, discoloration, and deterioration.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. 3M Window Film.
- B. Avery Dennison.
- C. Flexvue Films.
- D. Llummar.
- E. Madico, Inc.
- F. Substitutions: See Section 016000 - Product Requirements.

2.02 MATERIALS

- A. Glazing Film: Translucent polyester film for permanent bonding to glass.
 - 1. Basis-of-Design Product: 3M Crystal Glass 7725SE-324.
 - 2. Thickness: 4.7 mils, minimum.
 - 3. Color: Frosted White.
 - 4. Construction: Multi-ply laminate.
 - 5. Adhesive Type: Pressure sensitive acrylic.
 - 6. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84 (Class A).
- B. Accessory Materials: As recommended or required by film manufacturer.
- C. Glass Cleaner: As recommended by glazing film manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Field -Applied Film: Verify that existing conditions are adequate for proper application and performance of film.
- B. Examine glass and frames. Verify that existing conditions are adequate for proper application and performance of film.
- C. Verify glass is not cracked, chipped, broken, or damaged.
- D. Verify that frames are securely anchored and free of defects.
- E. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean glass of dust, dirt, paint, oil, grease, mildew, mold, and other contaminants that would inhibit adhesion.
- B. Immediately prior to applying film, thoroughly wash glass with neutral cleaning solution.
- C. Protect adjacent surfaces.
- D. Do not begin installation until substrates have been properly prepared.

3.03 INSTALLATION

- A. Do not apply glazing film when surface temperature is less than 40 degrees F or if precipitation is imminent.
- B. Install in accordance with manufacturer's instructions, without air bubbles, wrinkles, streaks, bands, thin spots, pinholes, or gaps, as required to achieve specified performance.
- C. Accurately cut film with straight edges to required sizes allowing 1/16 inch to 1/8 inch gap at perimeter of glazed panel unless otherwise required by anchorage method.
- D. Seams: Seam film only as required to accommodate material sizes; form seams vertically without overlaps and gaps; do not install with horizontal seams.
- E. Clean glass and anchoring accessories following installation. Remove excess sealants and other glazing materials from adjacent finished surfaces.
- F. Remove labels and protective covers.

3.04 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 088733

**SECTION 089100
LOUVERS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).
- B. AMCA 511 - Certified Ratings Program Product Rating Manual for Air Control Devices.

1.02 SUBMITTALS

- A. Product Data: Provide data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes.
- B. Shop Drawings: Indicate louver layout plan and elevations, opening and clearance dimensions, and tolerances; head, jamb and sill details; blade configuration, screens, blank-off areas required, and frames.
- C. Samples: Manufacturer's color charts indicating full range of available colors.
- D. Test Reports: Independent agency reports showing compliance with specified performance criteria.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified performance requirements.

1.03 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Provide five year manufacturer's warranty against distortion, metal degradation, and connection failures of louver components.
 - 1. Finish: Include twenty year coverage against degradation of exterior finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Louvers:
 - 1. Airline Louvers.
 - 2. Airolite Company, LLC.
 - 3. American Warming and Ventilating.
 - 4. Construction Specialties, Inc.
 - 5. Greenheck Fan Corporation.
 - 6. Industrial Louvers, Inc.
 - 7. NCA, a brand of Metal Industries Inc.
 - 8. Pottorff.
 - 9. Reliable Products, Inc.
 - 10. Ruskin.
 - 11. United Enertech.
 - 12. Substitutions: See Section 016000 - Product Requirements.

2.02 LOUVERS

- A. Louvers, General: All louvers shall be factory fabricated and assembled, complete with frame, mullions, and accessories; AMCA Certified in accordance with AMCA 511; provide AMCA Certified seal/markings on all louvers.
- B. Drainable-Blade Louvers: Horizontal blade, extruded aluminum construction. Provide at all indicated louvers.
 - 1. Basis-of-Design: Construction Specialties; A4097.
 - 2. Free Area: 50 percent, minimum.
 - 3. Free Area Velocity at Point of Beginning Water Penetration (0.01 oz. / ft²): Minimum 1000 fpm.
 - 4. Intake Pressure Drop at 0.01 oz. / ft² free area velocity: 0.20 in. H₂O, maximum.
 - 5. Blades: Drainable.
 - 6. Frame: 4 inches deep, channel profile; corner joints mitered, with continuous recessed caulking channel each side.
 - 7. Aluminum Thickness: Frame 0.80 12 gauge, 0.0808 inch minimum; blades 12 gauge, 0.0808 inch minimum.
 - 8. Aluminum Finish: High performance organic coatings; finished after fabrication.

2.03 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).

2.04 FINISHES

- A. Superior Performing Organic Coatings System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent PVDF resin, and at least 80 percent of aluminum extrusion and panels surfaces having minimum total dry film thickness (DFT) of 1.2 mils, 0.0012 inch.
- B. Color: To be selected by Architect from manufacturer's full range .

2.05 ACCESSORIES

- A. Blank-Off Panels: Aluminum face and back sheets, polyisocyanurate foam core, 1-1/2 inch thick, painted black on exterior side; provide where duct connected to louver is smaller than louver frame, sealing off louver area outside duct.
- B. Screens: Frame of same material as louver, with reinforced corners; removable, screw attached; installed on inside face of louver frame. Provide insect screens at intake louvers and at non-ducted louvers, and provide bird screens at exhaust louvers
 - 1. Bird Screen: Interwoven wire mesh of steel, 14 gauge, 0.0641 inch diameter wire, 1/2 inch open weave, diagonal design.
 - 2. Insect Screen: 18 x 16 size aluminum mesh.
- C. Fasteners: Concealed type; stainless steel. If exposed fasteners are unavoidable, provide color-matched heads to match framing color.
- D. Flashings: Of same material as louver frame, formed to required shape, single length in one piece per location.
- E. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that prepared openings and flashings are ready to receive this work and opening dimensions are as indicated on shop drawings.

3.02 INSTALLATION

- A. Install louver assembly in accordance with manufacturer's instructions.
- B. Install louvers level and plumb.
- C. Set sill members and sill flashing in continuous bead of sealant.
- D. Install flashings and align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.
- E. Secure louver frames in openings with concealed fasteners.
- F. Coordinate with installation of mechanical ductwork.

3.03 CLEANING

- A. Strip protective finish coverings.
- B. Clean surfaces and components.

END OF SECTION 089100

SECTION 092216
COLD FORMED STEEL FRAMING - NON-STRUCTURAL (CFSF-NS)

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

- A. Refer to Section 054000 - Cold-Formed Steel Framing - Structural (CFSF-S): Requirements for structural, load-bearing, metal stud framing and overhead/suspended/bulkhead framing.

1.02 REFERENCE STANDARDS

- A. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- D. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members.
- E. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members.
- F. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- G. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
- H. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board.

1.03 SUBMITTALS

- A. Product Data: Provide data describing framing member materials and finish, product criteria, load charts, and limitations.

PART 2 PRODUCTS

2.01 FRAMING MATERIALS

- A. Non-Loadbearing Framing System Components: AISI S220; sheet steel, of size and properties necessary for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf.
 - 1. Steel Thickness (Studs and Runners): Minimum 0.0179-inch (18 mil / 25 gauge) unless otherwise required to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf, and as indicated below:
 - a. Provide minimum 0.0329-inch thickness (33 mil / 20 gauge) for all partitions using 3-5/8-inch-deep studs where stud partition height is greater than 12 feet above floor level.
 - b. Provide minimum 0.0329-inch (33 mil / 20 gauge - Structural) for high-density board applications, such as ASTM C1178 tile backing panels and ASTM C1629 abuse- or impact-resistant gypsum board, and at door frames.
 - c. Provide minimum 0.0329-inch (33 mil / 20 gauge - Structural) for walls receiving heavy wall-hung items or loads, including but not limited to wall cabinets, wall-hung countertops, TV brackets, liquid tanks, folding and fixed seats, grab bars, handrails, exercise equipment, and shelving greater than 9 inches deep and over 3 feet in length.
 - 2. Studs: C-shaped with flat faces.

3. Runners: U-shaped, sized to match studs.
4. Furring: Hat-shaped sections, minimum depth of 7/8 inch.
5. Resilient Furring Channels: Single or double leg configuration; 1/2 inch channel depth.
- B. Deflection and Firestop Track: Intumescent strip factory-applied to track flanges expands when exposed to heat or flames to provide a perimeter joint seal.
- C. Non-Loadbearing Framing Accessories:
 1. Partial Height Wall Framing Support: Provides stud reinforcement and anchored connection to floor.
 - a. Materials: ASTM A36/A36M formed sheet steel support member with factory-welded ASTM A1003/A1003M steel plate base.
 2. Bracing and Bridging: ASTM A653/A653M G90 galvanized steel; cold-rolled channel / hat-section profile; for lateral bracing of wall studs with slots for engaging on-module studs.
 3. Framing Connectors: ASTM A653/A653M steel clips; secures cold rolled channel to wall studs for lateral bracing.
 4. Sheet Metal Backing: 0.036 inch thick flat strap/plate.
 5. Fasteners: Self-tapping screws designed for attachment of metal framing and recommended by manufacturer.
 6. Anchorage Devices: Powder actuated or screw anchors with sleeves, recommended by manufacturer for anchorage to indicated substrates.
 7. Acoustic Insulation: ASTM C665; preformed mineral-fiber, friction fit type, unfaced. Thickness as indicated, or sized to fit stud depth indicated.
 8. Acoustic Sealant: Refer to Division 07 Section "Joint Sealants."
- D. Isolation Strips: Provide either closed-cell foam tape with rubberized adhesive membrane or asphalt-saturated organic felt (ASTM D226, Type I, No. 15).

2.02 GYPSUM BOARD SUSPENSION SYSTEM

- A. For interior overhead gypsum board, in lieu of separate stick built fixed-framing bulkheads and soffits fabricated of Structural Cold-Formed Steel Framing (CFSF-S), Contractor may provide a direct hung suspension system, per ASTM C645, composed of pre-fabricated beams and cross-furring members, specifically designed for use with gypsum board.
- B. Products:
 1. Armstrong; Quikstix Drywall Grid System.
 2. Certainteed; 1-1/2" Drywall Suspension System.
 3. Rockfon; Chicago Metallic Drywall Grid System.
 4. USG; Drywall Suspension System.

2.03 FABRICATION

- A. Fabricate assemblies of framed sections to sizes and profiles required.
- B. Fit, reinforce, and brace framing members to suit design requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that rough-in utilities are in proper location.

3.02 INSTALLATION OF STUD FRAMING

- A. Install in accordance with ASTM C754. Provide framing, including bracing, bridging, and anchorage accessories, to meet L/240 deflection limit at a lateral pressure of 5 psf unless indicated otherwise.
 - 1. Gypsum Board: At gypsum board partitions and assemblies, comply with applicable requirements of ASTM C840 for framing installation.
 - 2. Install a continuous isolation strip where studs or stud-framed partitions directly abut dissimilar metals or exterior masonry wall.
- B. Extend partition framing to deck at locations indicated, and to a height 4 inches above ceiling level at all other locations, unless otherwise indicated.
- C. Partitions Terminating to Deck: Secure partitions to building structure in accordance with Structural Drawings. Do not fasten runner directly to floor/roof deck; provide clearance for firestopping. Coordinate with Section 078400 - Firestopping for head-of-wall joint firestopping assemblies and firestopping around structural elements as required.
- D. Partitions Terminating Above Ceiling: Attach studs to runner using specified mechanical devices in accordance with manufacturer's instructions. Brace runners to structural elements in accordance with Structural Drawings.
- E. Align and secure top and bottom runners at maximum 24 inches on center.
- F. At partitions indicated with an acoustic rating:
 - 1. Provide components and install as required to produce STC ratings as indicated, based on published tests by manufacturer conducted in accordance with ASTM E90 with STC rating calculated in accordance with ASTM E413.
- G. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.
- H. Install studs vertically at 16 inches on center, unless otherwise indicated.
- I. Align stud web openings horizontally.
- J. Secure studs to tracks using crimping method. Do not weld.
- K. Fabricate corners using a minimum of three studs.
- L. Install double studs at wall openings, door and window jambs, not more than 2 inches from each side of openings.
- M. Install bracing, bridging, and anchorage to brace stud framing system rigid.
- N. Coordinate erection of studs with requirements of door frames; install supports and attachments.
- O. Coordinate installation of bucks, anchors, and blocking with electrical, mechanical, and other work to be placed within or behind stud framing.
- P. Blocking: Use FRT wood blocking or metal channel stud blocking, secured to studs. Provide blocking for support of plumbing fixtures, toilet partitions, wall cabinets, toilet accessories, hardware, opening frames, and other built-in-place wall mounted items and equipment.
- Q. Furring: Install at spacing and locations shown on drawings. Lap splices a minimum of 6 inches.

3.03 GYPSUM BOARD SUSPENSION SYSTEM

- A. Install suspension system in accordance with manufacturer's instructions. Do not attach overhead suspension hangers to or suspend from steel floor or roof deck; fasten to primary

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structural beams/joists or provide intermediate slotted track as supplemental structure between primary structural elements.

3.04 TOLERANCES

- A. Maximum Variation From True Position: 1/8 inch in 10 feet.
- B. Maximum Variation From Plumb: 1/8 inch in 10 feet.

END OF SECTION 092216

**SECTION 092400
CEMENT PLASTERING**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- C. ASTM C91/C91M - Standard Specification for Masonry Cement.
- D. ASTM C150/C150M - Standard Specification for Portland Cement.
- E. ASTM C206 - Standard Specification for Finishing Hydrated Lime.
- F. ASTM C847 - Standard Specification for Metal Lath.
- G. ASTM C897 - Standard Specification for Aggregate for Job-Mixed Portland Cement-Based Plasters.
- H. ASTM C926 - Standard Specification for Application of Portland Cement-Based Plaster.

1.02 SUBMITTALS

- A. Product Data: Provide data on plaster materials and trim accessories.

1.03 FIELD CONDITIONS

- A. Interior Plaster Work: Maintain minimum ambient temperature of 50 degrees F during installation of plaster and until fully cured.

PART 2 PRODUCTS

2.01 CEMENT PLASTER APPLICATIONS

- A. Lath Plaster Base: Metal diamond security lath.
 - 1. Number of Coats: For bid purposes assume 3 coats, with a total thickness of approximately 1/2- to 9/16-inch. Verify number of coats and thicknesses with existing to match total thickness, surface texture, and finish.
 - 2. First Coat: Apply to a nominal thickness of 3/8 inch.
 - 3. Leveling Coat: Apply to a nominal thickness of 1/32 to 1/16 inch.
 - 4. Finish Coat: Apply to a nominal thickness of 1/8 inch.

2.02 JOBSITE MIXED CEMENT PLASTER

- A. Materials:
 - 1. Portland Cement: ASTM C150/C150M, Type I.
 - 2. Masonry Cement: ASTM C91/C91M, Type N.
 - 3. Lime: ASTM C206 Type S.
 - 4. Sand: Clean, well graded, and complying with ASTM C897.
 - 5. Water: Clean, fresh, potable, and free of mineral or organic matter that could adversely affect plaster.
 - 6. Plaster Mix Reinforcement: Glass fibers, chopped to 1/2 inch nominal length, and alkali resistant.

- B. Plaster Mixes: Proportioned in accordance with ASTM C926; parts by volume.
 - 1. First Coat Over Lath:
 - a. Plaster Mix "C": One part Portland cement, with minimum zero part and maximum 3/4 part hydrated lime.
 - b. Minimum 2-1/2 parts and maximum 4 parts sand, per total volume of cementitious materials.
 - c. Provide fiber reinforcement at 1-1/2 lbs per sack of cement.
 - 2. Second Coat: Same mixture as first coat, without fiber reinforcement, except minimum 3 parts and maximum 5 parts sand.
 - 3. Finish Coat:
 - a. Plaster Mix "F": One part Portland cement, with minimum 3/4 part and maximum 1-1/2 parts hydrated lime.
 - b. Minimum 1-1/2 parts and maximum 3 parts sand, per total volume of cementitious materials.

2.03 ACCESSORIES

- A. Expanded-Metal Diamond Security Lath:
 - 1. Wire Size: 16 gauge, 0.0598 inch.
 - 2. Galvanized Steel: Provide expanded metal fabricated of ASTM C847 cold-formed steel sheet, galvanized to ASTM A653/A653M, minimum G60.
 - 3. Opening Size: Approx 0.5 inches wide maximum, by 1.5 inch long maximum..
 - 4. Weight: Approx 0.86 lb per sq ft.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions are acceptable prior to starting this work.

3.02 MIXING

- A. Mix only as much plaster as can be used prior to initial set.
- B. Mix materials dry, to uniform color and consistency, before adding water.
- C. Protect mixtures from frost or freezing temperatures, contamination, and excessive evaporation.

3.03 APPLICATION

- A. Lath Installation: Install security lath in accordance with manufacturer's recommendations.
- B. Apply plaster in accordance with manufacturer's written instructions and comply with ASTM C926.
- C. Base Coats:
 - 1. Apply base coat(s) to fully embed lath and to specified thickness.
 - 2. Follow guidelines in ASTM C926 and manufacturer's written installation instructions for moist curing base coats and application of subsequent coats.
- D. Leveling Coat:
 - 1. Apply leveling coat to specified thickness.
- E. Finish Coats:

1. Cement Plaster:

- a. Apply with sufficient material and pressure to ensure complete coverage of base to specified thickness.
- b. Apply desired surface texture while mix is still workable. Field verify existing surface texture and finish and match new to existing.
- c. Float to a consistent finish.

3.04 TOLERANCES

- A. Maximum Variation from True Flatness: 1/4 inch in 10 feet.

3.05 REPAIR

- A. Patching: Remove loose, damaged or defective plaster and replace with plaster of same composition; finish to match surrounding area.

END OF SECTION 092400

**SECTION 092900
GYPSUM BOARD**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
- B. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
- C. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- D. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board.
- E. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
- F. ASTM C1396/C1396M - Standard Specification for Gypsum Board.
- G. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels.
- H. ASTM C1658/C1658M - Standard Specification for Glass Mat Gypsum Panels.
- I. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
- J. GA-216 - Application and Finishing of Gypsum Panel Products.
- K. UL 752 - Standard for Bullet-Resisting Equipment.

1.02 SUBMITTALS

- A. Product Data:
 - 1. Provide data on gypsum board, accessories, and joint finishing system.
- B. Ballistic Test Reports: Indicate compliance of bullet-resistant sheathing and wallboard assemblies with specified requirements.

1.03 DELIVERY, STORAGE, HANDLING, AND FIELD CONDITIONS

- A. Do not deliver or install until building is weather-tight and conditioned.
- B. Store materials in dry and clean location until needed for installation. During installation, handle in a manner that will prevent damage and to prevent marring and soiling of finished surfaces.
- C. Do not install gypsum products that have gotten wet or moldy, or show signs of past moisture damage.
- D. Maintain uniform temperature and humidity at occupancy conditions during and after installation. Allow products to acclimatize prior to installation.

PART 2 PRODUCTS

2.01 BOARD MATERIALS

- A. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; with tapered edges.

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1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - a. Mold-resistant board is required whenever gypsum board is indicated in rooms subject to steam or water, including mechanical rooms, toilet rooms, custodial rooms, and kitchens.
 3. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
 4. Thickness:
 - a. Vertical Surfaces: 5/8 inch.
 - b. Ceilings: 5/8 inch.
 - c. Curved Surfaces: Provide flexible 1/4 inch thickness gypsum board, installed in two layers.
- B. Impact Resistant Wallboard:
1. Surface Abrasion: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
 2. Indentation: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
 3. Soft Body Impact: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
 4. Hard Body Impact: Level 2, minimum, when tested in accordance with ASTM C1629/C1629M.
 5. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 6. Paper-Faced Type: Gypsum wallboard, as defined in ASTM C1396/C1396M.
 7. Glass Mat-Faced Type: Gypsum wallboard, as defined in ASTM C1658/C1658M.
 8. Type: Fire-resistance-rated Type X, UL or WH listed.
 9. Thickness: 5/8 inch.
 10. Edges: Tapered.
 11. Paper-Faced Products:
 - a. American Gypsum Company; M-Bloc IR Type X.
 - b. CertainTeed Corporation; Extreme Impact Resistant Drywall with M2Tech.
 - c. National Gypsum Company; Gold Bond Hi-Impact XP Gypsum Board.
 - d. Substitutions: See Section 016000 - Product Requirements.
 12. Glass Mat Faced Products:
 - a. Georgia-Pacific Gypsum; DensArmor Plus Impact-Resistant.
 - b. USG Corporation; USG Sheetrock Brand Glass-Mat Panels Mold Tough VHI.
 - c. Substitutions: See Section 016000 - Product Requirements.
- C. Bullet Resistant Sheathing and Wallboard: Woven roving, multi-ply, ballistic grade fiberglass cloth with thermoset polyester resin; comply with UL 752 Level 3. Size boards to minimize joints.
1. Thickness: Nominal 7/16 inch or 1/2 inch as standard with manufacturer.
 2. Available Products:
 - a. ArmorCore by Waco Composites; Bullet Resistant Fiberglass Panels.
 - b. Armortex, Div. of Safeguard Security System, Inc.; OF 300.
 - c. Chicago Bullet Proof Systems; Fibre-Tex.
 - d. C.R. Laurence of North America; BRF300.
 - e. Insulgard Corporation; FG-300.

2.02 GYPSUM BOARD ACCESSORIES

- A. Sound Attenuation Batts: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness sized to fit metal stud cavity.
- B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant. Refer to sealant AS-1 in Division 07 Section "Joint Sealants."
- C. Putty Pads: Non-hardening endothermic material, in pad form, faced on both sides with poly liner, designed to seal around penetrations and wiring devices, enhancing acoustic performance.
 - 1. Nominal Size: 7-1/4 x 7-1/4 x 3/16 inches.
 - 2. Available Products:
 - a. 3M; Fire Barrier Moldable Putty Pads MPP+.
 - b. Hilti; Firestop Putty Pad, CFS-P PA.
 - c. Specified Technologies, Inc.; SpecSeal Putty Pad.
- D. Beads, Joint Accessories, and Other Trim: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
 - 1. Corner Beads: Low profile, for 90 degree outside corners.
 - 2. L-Bead, LC-Bead, and U-Bead: Sized to fit gypsum wallboard size(s) indicated.
 - a. Provide LC-bead at exposed panel edges and U-bead at concealed panel edges, unless otherwise indicated. Provide L-bead at locations indicated.
- E. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
- F. Security Barrier Mesh: ASTM F 1267, Type II, Class 1; expanded and flattened diamond mesh security barrier. Fabricate of uncoated, minimum 18 gage carbon steel, weight 0.66 lbs/sq. ft. Provide with lath mesh size approximately 1/2-inch by 1-1/4-inch.
 - 1. Mesh Fasteners: Provide fasteners that are non-corrosive to both mesh and framing substrate; as recommended by manufacturer for mesh-to-mesh and mesh-to-framing fastening.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.

3.02 ACOUSTIC ACCESSORIES INSTALLATION

- A. Sound Attenuation Batts: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Acoustic Sealant: Install in accordance with manufacturer's instructions.

3.03 BOARD INSTALLATION

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
- C. Double-Layer, Nonrated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Use glass mat faced gypsum board

at exterior walls and at other locations as indicated. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.

- D. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- E. Security Gypsum Partitions and Ceilings: At security gypsum assemblies indicated, install expanded/flattened metal security barrier mesh followed by impact resistant gypsum board.
- F. Install gypsum board with an open horizontal joint (gap) not to exceed 5/8-inch above finished floor slab, and tape and finish vertical joints to bottom edge of board to afford a smooth substrate for applied wall base.
- G. Bullet Resistant Sheathing and Wallboard:
 - 1. Install bullet-resistant sheathing according to manufacturer's written recommendations and with manufacturer-approved fasteners.
 - 2. Cover all joints between boards with a 4-inch strip of the same thickness material as the boards, centered on the joint.

3.04 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints in compliance with ASTM C 840, consistent with lines of building spaces, and as indicated.
 - 1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
 - 2. At exterior soffits, not more than 30 feet apart in both directions.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Putty Pads: Install putty pads on the backside of items penetrating gypsum board on STC-rated walls/partitions. Items include, but are not limited to, wiring devices, cable, conduit, and pipe. Completely cover and seal around each penetration.

3.05 JOINT TREATMENT

- A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
 - 1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
 - 2. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
 - 3. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.
- B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
 - 1. Feather coats of joint compound so that camber is maximum 1/32 inch.
- C. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.06 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION 092900

**SECTION 095100
ACOUSTICAL CEILINGS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- C. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- E. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions.
- F. ASTM E1264 - Standard Classification for Acoustical Ceiling Products.

1.02 SUBMITTALS

- A. Shop Drawings: Indicate grid layout and related dimensioning.
- B. Product Data: Provide data on suspension system components, acoustical units, and accessories.
- C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Refer to Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Acoustical Panels: Quantity equal to 2 percent of total installed, of each type.
- D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.03 QUALITY ASSURANCE

- A. Source Limitations: Provide each acoustical ceiling assembly (ceiling panel and suspension system) from a single manufacturer to obtain manufacturer's system warranty.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver until building is weather-tight and conditioned.
- B. Store materials in dry and clean location until needed for installation. During installation, handle in a manner that will prevent damage and to prevent marring and soiling of finished surfaces.

1.05 FIELD CONDITIONS

- A. Maintain uniform temperature and humidity at occupancy conditions during and after acoustical unit installation. Allow products to acclimatize prior to installation.

1.06 WARRANTY

- A. System Warranty: Provide a single source system warranty covering both acoustical ceiling panels and suspension system.
 - 1. Warranty shall cover material failures including sag, warping, shrinkage, or delamination, biologic growth including mold or mildew, and rusting of suspension system.
 - 2. Warranty Period: Minimum 15 years, from date of Substantial Completion.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Surface Burning Characteristics: Each acoustical ceiling shall be Class A rated, with flame spread index of 25 or less, smoke developed index of 50 or less, when tested in accordance with ASTM E84.
- B. Seismic Performance: Ceiling systems designed to withstand the effects of earthquake motions determined according to ASCE 7, which references applicable requirements of ASTM E580/E580M "Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Subject to Earthquake Ground Motions." for Seismic Design Category indicated on Structural Drawings and complying with local authorities having jurisdiction.

2.02 ACOUSTICAL PANELS

- A. Acoustical Panels - General: ASTM E1264, Class A.
 - 1. Antibacterial/Antimicrobial Treatment: Provide acoustical panels that have been factory-treated by manufacturer for resistance to bacteria, mold, mildew, and fungus.
 - 2. Humidity/Sag Treatment: Provide acoustical panels that have been factory-treated by manufacturer for humidity and sag-resistance.
- B. Acoustical Panels ACP-A: Mineral fiber with membrane-faced overlay, with the following characteristics:
 - 1. Classification: ASTM E1264 Type IV.
 - a. Form: 2, water felted.
 - b. Pattern: "E" - lightly textured.
 - 2. Size: 24 by 24 inches.
 - 3. Thickness: 3/4 inch.
 - 4. Light Reflectance: Not less than 0.88, determined in accordance with ASTM E1264.
 - 5. NRC Range: Not less than 0.75, determined in accordance with ASTM E1264.
 - 6. Ceiling Attenuation Class (CAC): Not less than 35, determined in accordance with ASTM E1264.
 - 7. Panel Edge: Square.
 - 8. Color: White.
 - 9. Suspension System: Exposed grid.
 - 10. Products:
 - a. Armstrong World Industries, Inc; Ultima - Item #1910.
 - b. CertainTeed Ceilings, Inc.; Symphony m - Item #1222-75-1.
 - c. USG Corporation; Mars Acoustical Panels - Item #86185.
 - d. Substitutions: See Section 016000 - Product Requirements.
- C. Acoustical Panels ACP-B: Glass fiber with membrane-faced overlay, with the following characteristics:
 - 1. Classification: ASTM E1264 Type XII.
 - a. Form: 1 - plastic, or 2 - cloth.
 - b. Pattern: "E" - lightly textured.
 - 2. Size: 24 by 24 inches.
 - 3. Thickness: Not less than 3/4 inch.
 - 4. Light Reflectance: Not less than 0.86, determined in accordance with ASTM E1264.
 - 5. NRC Range: Not less than 0.95, determined in accordance with ASTM E1264.

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6. Panel Edge: Square.
7. Tile Edge: Square.
8. Color: White.
9. Suspension System: Exposed.
10. Products:
 - a. Armstrong World Industries, Inc; Optima Health Zone - Item #3114.
 - b. CertainTeed Ceilings, Inc; Symphony f Rx - Item #1342-RXS-1.
 - c. USG Corporation; Halcyon Healthcare Acoustical Panels - Item #98232.
 - d. Substitutions: See Section 016000 - Product Requirements.

2.03 SUSPENSION SYSTEM(S)

- A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.
 1. Materials:
 - a. Steel Grid: ASTM A653/A653M, G30 coating, unless otherwise indicated.
 2. Cross Tee/Main Runner Connection: Override (stepped).
 3. Main Runner End Coupling: Bayonet ("stab") type; knuckle type is not acceptable.
- B. Exposed Suspension System: Hot-dipped galvanized steel grid with aluminum cap.
 1. High Humidity Applications: Provide in kitchens, rooms with showers, custodial rooms, mechanical rooms, and other rooms where increased corrosion resistance due to humidity or steam is required.
 2. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
 3. Coating: Provide minimum G60 hot-dip galvanized coating.
 4. Profile: Tee; 15/16 inch face width.
 5. Finish: Baked enamel.
 6. Color: White.
 7. Products:
 - a. Armstrong World Industries, Inc; Prelude Plus XL Fire Guard.
 - b. CertainTeed Ceilings, Inc; 15/16" EZ Stab Classic Environmental System.
 - c. USG Corporation; Donn Brand ZXLA 15/16 inch Acoustical Suspension System.
 - d. Substitutions: See Section 016000 - Product Requirements.
- C. Exposed Suspension System: Hot-dipped galvanized steel grid and cap.
 1. Applications: Provide in all locations where aluminum capped system above is not required.
 2. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
 3. Profile: Tee; 15/16 inch face width.
 4. Finish: Baked enamel.
 5. Products:
 - a. Armstrong World Industries, Inc; Prelude XL 15/16".
 - b. CertainTeed Ceilings, Inc; 15/16" EZ Stab Classic System.
 - c. USG Corporation; Donn Brand DX/DXL 15/16 inch Acoustical Suspension System.
 - d. Substitutions: See Section 016000 - Product Requirements.

2.04 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- B. Hanger Wire: 12 gauge, 0.08 inch galvanized steel wire.
- C. Hold-Down Clips: Manufacturer's standard clips to suit application.
- D. Perimeter Moldings: Same metal and finish as grid.
 - 1. Acoustical Sealant For Perimeter Moldings: Refer to Section 079200 - Joint Sealants for acoustical sealant for use in conjunction with suspended ceiling system.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

3.02 PREPARATION

- A. Install after major above-ceiling work is complete.
- B. Coordinate the location of hangers with other work.

3.03 INSTALLATION - SUSPENSION SYSTEM

- A. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- B. Lay out system to a balanced grid design with edge units no less than 50 percent of acoustical unit size.
- C. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
 - 1. Use longest practical lengths.
 - 2. Apply acoustical sealant in a continuous bead at top edge of vertical legs of moldings after they are installed.
- D. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
 - 1. Do not hang suspension system directly from steel floor or roof deck.
- E. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- F. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- G. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
- H. Do not eccentrically load system or induce rotation of runners.

3.04 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

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- C. Fit border trim neatly against abutting surfaces.
- D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- E. Cutting Acoustical Units:
 - 1. Make field cut edges of same profile as factory edges.
- F. Where round obstructions and bullnose concrete block corners occur, provide preformed closures to match perimeter molding.
- G. At all ACP within the secure perimeter, install hold-down clips on each panel to retain panels tight to grid system.

3.05 TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION 095100

**SECTION 096513
RESILIENT BASE AND ACCESSORIES**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
- B. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile.
- C. ASTM F1861 - Standard Specification for Resilient Wall Base.
- D. ASTM F2169 - Standard Specification for Resilient Stair Treads.
- E. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

1.02 SUBMITTALS

- A. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- B. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.
- C. Verification Samples: Submit in manufacturer's standard size, illustrating color and pattern for each resilient flooring product specified.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- C. Protect roll materials from damage by storing on end.

1.04 FIELD CONDITIONS

- A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.
- B. Maintain conditions at occupancy conditions for installation and until Substantial Completion.

PART 2 PRODUCTS

2.01 RESILIENT BASE

- A. Resilient Base: ASTM F1861, Type TP, rubber, thermoplastic; Style B, Cove.
 - 1. Products (Type TP):
 - a. Flexco (USA), Inc.; Flexco Base 2000 - Cove.
 - b. Johnsonite, a Tarkett Company; Rubber Wall Base - Cove.
 - c. Mannington Commercial; Burkebase Type TP - Cove.
 - d. Roppe Corporation; 700 Series TPR Wall Base - Style B (Coved).
 - 2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.

3. Height: 4 inch.
4. Thickness: 0.125 inch minimum.
5. Finish: Satin.
6. Length: Roll; manufacturer's standard length.
7. Color: To be selected by Architect from manufacturer's full range.

2.02 MOLDINGS, TRANSITIONS, AND EDGE STRIPS

- A. Moldings, Transition and Edge Strips:
1. Manufacturers:
 - a. Flexco, Inc.
 - b. Johnsonite.
 - c. Mannington Commercial.
 - d. Roppe Corporation.
 2. Molding/Transition Strip Profiles: Provide in sizes as required to suit flooring thicknesses and applications.
 - a. Coved edge/cap for carpet.
 - b. Joiner between carpet and resilient flooring or other materials with different heights.
 - c. Transition strip between different types of materials that are the same height or between different styles/patterns of the same material.
 - d. Slim transition strip with approximately 1/4-inch wide visible transition profile.
 - e. Reducer strip at edges of flooring to reduce height to 0".
 - f. Subfloor leveling accessory to transition between materials with height differences up to 1/2 inch.
 3. Material: Manufacturer's standard rubber.
 4. Color: To be selected by Architect from manufacturer's full range.

2.03 ACCESSORIES

- A. Leveling Compound: Blended cement mix, latex-modified, for use as trowelable underlayment, approved by resilient accessory manufacturer.
- B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.
1. Do not apply wall base until other finish items, including casework and painting, are complete.

3.02 PREPARATION

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

- B. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with leveling compound to achieve smooth, flat, hard surface.
- C. Prohibit traffic until leveling compound is fully cured.
- D. Clean substrate.

3.03 INSTALLATION - GENERAL

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install in accordance with manufacturer's written instructions.
- C. Adhesive-Applied Installation:
 - 1. Fit joints and butt seams tightly.
 - 2. Set flooring in place, press with heavy roller to attain full adhesion.
- D. Where type of floor finish, pattern, or color are different on opposite sides of door, install such that molding profiles or transition strips are centered under the door panel.
- E. Install edge/reducer strips at unprotected or exposed edges, where flooring terminates, and where indicated.
 - 1. Resilient Strips: Attach to substrate using adhesive.

3.04 INSTALLATION - RESILIENT BASE

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
- B. Install base on solid backing. Bond tightly to wall and floor surfaces.
- C. Job form internal and external corners in accordance with manufacturer's instructions. Form corners by "V" cutting or scribing; do not bend material in a manner that creates stress whitening.
- D. In addition to walls, install base on other permanent construction with exposed vertical faces at floor level, including, but not limited to, columns, pilasters, and casework/cabinet knee and toe spaces.
- E. Scribe and fit to door frames and other interruptions.
- F. At uneven substrate surfaces (such as masonry mortar joints), provide manufacturer's recommended filler sealant or adhesive to fill voids along top of base.

3.05 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.

3.06 PROTECTION

- A. Prohibit traffic on resilient accessories for 48 hours after installation.
- B. Cover resilient accessories and protect from heavy construction traffic and equipment until Substantial Completion.

END OF SECTION 096513

**SECTION 096516
RESILIENT SHEET FLOORING**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
- B. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
- C. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
- D. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
- E. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

1.02 SUBMITTALS

- A. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- B. Shop Drawings: Indicate seaming plans, floor patterns, and dye lot.
- C. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Store all materials off of the floor in an acclimatized, weather-tight space.
- C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.

1.04 FIELD CONDITIONS

- A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

1.05 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Manufacturer's Warranty: Provide a ten (10) year manufacturer warranty, covering defective material and installation.
- C. Installer's Warranty: Installer shall warrant that the products have been installed in accordance with manufacturer's instructions.
 - 1. The installer shall provide a ten (10) year warranty against product failure due to excessive moisture vapor transmission through the slab.

PART 2 PRODUCTS

2.01 SHEET FLOORING

- A. Vinyl Sheet Flooring - Type SV-A - Clinic: Homogeneous without backing, with color and pattern throughout full thickness.
 - 1. Manufacturers:
 - a. Basis-of-Design: Armstrong Flooring; Medintone.
 - b. Gerflor USA, Inc; Mipolam Affinity.
 - c. Mannington Commercial; BioSpec MD.
 - 2. Minimum Requirements: Comply with ASTM F1913.
 - 3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
 - 4. Thickness: 0.080 inch nominal.
 - 5. Seams: Heat welded.
 - 6. Integral coved base with cap strip.
 - 7. Color: To be selected by Architect from manufacturer's full range.
- B. Vinyl Sheet Flooring - Type SV-B - Kitchen: Color and pattern throughout wear layer thickness, with backing.
 - 1. Manufacturers:
 - a. Altro Floors; Atlas 40.
 - b. Basis-of-Design: Oscoda Plastics, Inc; Protect-All Specialty Flooring.
 - c. Polyflor Ltd; Polysafe Apex.
 - 2. Minimum Requirements: Comply with ASTM F1303, Type II, except for wear-layer binder content and backing requirements. Provide un-backed floor covering.
 - 3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
 - 4. Total Thickness: 0.25 inch minimum.
 - 5. Sheet Width: As standard with manufacturer.
 - 6. Seams: Heat welded.
 - 7. Integral coved base cap with rubber strip.
 - 8. Color: To be selected by Architect from manufacturer's full range.
- C. Welding Rod: Solid bead in material compatible with flooring, produced by flooring manufacturer for heat welding seams, and in color matching field color.

2.02 ACCESSORIES

- A. Subfloor Filler: Type recommended by adhesive material manufacturer.
- B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.
- C. Moisture Vapor Treatment (MVT): Where resilient flooring and accessories are installed over concrete slabs, and where field testing indicates high moisture vapor testing through concrete slabs, provide alkaline-resistant product designed to control excessive moisture vapor transmission through concrete slab in accordance with Division 01 MVT allowance and unit price, and per the following:
 - 1. Products: Provide product approved by flooring manufacturer and complying with performance requirements below, equivalent to one of the following:
 - a. Duraamen Engineered Products, Inc.; Perdure MVT.

- b. Maxxon Corporation; Maxxon MVP.
 - c. Tnemec Company Inc.; Epoxoprime MVT, Series 208.
- 2. Performance Requirements:
 - a. Verify with flooring manufacturer that submitted product maintains compliance with all provisions of flooring manufacturer's warranty.
 - b. Low-VOC: Provide product with VOC content less than 15 g/L.
 - c. Bond Strength to Concrete: Minimum 400 psi per ASTM D 4541 (100% concrete failure).
 - d. Permeance: Maximum 0.1 perm per ASTM E 96, and 0.10 grains/hr/ft²/in-Hg, per ASTM F3010.
 - e. Applications: Provide MVT for all concrete slabs on-grade and lightweight concrete elevated slabs.
- D. Floor Drain Rings: Stainless steel drain accessories, recommended by sheet vinyl flooring manufacturer, fabricated for use with flanged floor drain specified in Division 22 for permanent, non-leaking floor drain installation in sheet flooring at wet or kitchen areas indicated.
 - 1. Manufacturers:
 - a. Campbell Grinding & Machine; Lewisville, TX.
 - b. MO Manufacturing; El Dorado Springs, MO.
 - c. Stainless Steel Fabricators; Raleigh, NC.
 - d. Stainless Steel Works, Inc; Salt Lake City, UT.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
 - 1. Test as Follows: Perform a minimum of one of each test per 1,000 sf of installation area.
 - a. Alkalinity (pH): ASTM F710.
 - b. Internal Relative Humidity: ASTM F2170.
 - c. Moisture Vapor Emission: ASTM F1869.
 - 2. If test results are not within limits recommended by flooring manufacturer, apply moisture vapor treatment (MVT) in accordance with manufacturer's requirements. MVT shall be provided per unit price and quantity allowance requirements.

3.02 PREPARATION

- A. Remove existing resilient flooring and flooring adhesives; follow the recommendations of RFCI (RWP).
- B. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- C. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.
- D. Prohibit traffic until filler is fully cured.
- E. Clean substrate.

3.03 INSTALLATION - GENERAL

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install in accordance with manufacturer's written instructions.
- C. Adhesive-Applied Installation:
 - 1. Fit joints and butt seams tightly.
 - 2. Set flooring in place, press with heavy roller to attain full adhesion.
- D. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- E. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
- F. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.04 INSTALLATION - SHEET FLOORING

- A. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns at seams.
- B. Seal seams by heat welding
- C. Coved Base: Install as detailed on drawings, using coved base filler as backing at floor to wall junction. Extend sheet flooring vertically to height indicated, and cover top edge with metal cap strip.

3.05 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.

3.06 PROTECTION

- A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION 096516

**SECTION 096700
FLUID-APPLIED FLOORING AND WALLS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM D695 - Standard Test Method for Compressive Properties of Rigid Plastics.
- B. ASTM D4060 - Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
- C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
- D. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
- E. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
- F. ICRI 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.
- G. SCAQMD 1113 - Architectural Coatings.

1.02 ADMINSTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene at project site seven calendar days prior to scheduled beginning of construction activities of this section to review section requirements.
 - 1. Require attendance by representatives of installer and other entities directly affecting, or affected by, construction activities of this section.
 - 2. Notify Architect four calendar days in advance of scheduled meeting date.

1.03 SUBMITTALS

- A. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns and colors available.
- B. Selection Samples: Provide manufacturer's color charts illustrating full range of patterns and colors for each flooring material.
- C. Verification Samples: Manufacturer's standard size physical samples, on rigid backing, illustrating each selected pattern and color.
- D. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.
- E. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and application rate for each coat.
- F. Applicator's Qualification Statement.
- G. Field Quality Control Reports: Submit inspection reports of manufacturer's technical representative.
- H. Maintenance Data: Include maintenance procedures, recommended maintenance materials, procedures for stain removal, repairing surface, and suggested schedule for cleaning.

1.04 QUALITY ASSURANCE

- A. Applicator Qualifications: Company specializing in performing the work of this section; certified and approved by manufacturer in writing.
 - 1. Approved by manufacturer.

1.05 MOCK-UPS

- A. Construct mock-up(s) of fluid applied flooring to serve as basis for evaluation of texture and workmanship.
 - 1. Number of Mock-Ups to be Prepared: One.
 - 2. Use same materials and methods for use in the work.
 - 3. Use approved design samples as basis for mock-ups.
 - 4. Locate where directed by Architect.
 - 5. Minimum Size: 48 inches by 48 inches.
- B. See Section 014000 - Quality Requirements for additional requirements.
- C. Obtain approval of mock-up by Architect before proceeding with work.
- D. Approved mock-up may remain as part of the work.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store resin materials in a dry, secure area.
- B. Store materials for three days prior to installation in area of installation to achieve temperature stability.

1.07 FIELD CONDITIONS

- A. Maintain minimum temperature in storage area of 55 degrees F.
- B. Store materials in area of installation for minimum period of 24 hours prior to installation.
- C. Maintain ambient temperature required by manufacturer 72 hours prior to, during, and 24 hours after installation of materials.

PART 2 PRODUCTS

2.01 FLUID-APPLIED FLOORING SYSTEMS

- A. Fluid-Applied Flooring (RES-Toilet & Shower area floors): Hybrid cementitious urethane base coat and top coat, and epoxy color coat with broadcast aggregate.
 - 1. Aggregate: Decorative Flake
 - 2. Top Coat: Manufacturer's chemical resistant polyurethane.
 - 3. System Thickness: 1/8 inch, nominal, dry film thickness (DFT).
 - 4. VOC Content: Maximum 50 g/L in accordance with SCAQMD 1113.
 - 5. Texture: Slip resistant.
 - 6. Sheen: Semi-gloss.
 - 7. Color: To be selected by Architect from manufacturer's full range.
 - 8. Products:
 - a. Elite Crete Systems; Hermetic Quartz Flooring System.
 - b. Key Resin Company; Key Quartz System.
 - c. Neogard; NeoQuartz Broadcast System.
 - d. Sherwin-Williams Company; Resuflor Deco Quartz BC23. Basis of Design
 - e. Sika Corporation; Sikafloor Decodur Quartz System.
 - f. Stonhard; Stonshield HRI.
 - g. TNEMEC; 1/8" Deco-Tread Quartz System.

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- B. Fluid-Applied Wall System (RES-Toilet & Shower area walls): Polyurethane or epoxy primer and CMU block filler base coat(s) and pigmented polyurethane top coats.
 - 1. System Thickness: 11 mils, nominal, dry film thickness (DFT).
 - 2. Texture: Smooth.
 - 3. Sheen: Satin.
 - 4. Color: To be selected by Architect from manufacturer's full range.
 - 5. Products:
 - a. Dur-A-Flex; Dur-A-Wall HP. Basis of Design
 - b. Key Resin Company; Epoxy/Urethane Wall System.
 - c. Neogard; Wall-Gard HD.
 - d. Sherwin-Williams; Resuwall FX.
 - e. Sika Corporation; Sikagard-WB.
 - f. TNE MEC; Enviro-Glaze Series 297 Top Coat with Enviro-Crete Series 156 Primer and Block Filler.

2.02 ACCESSORIES

- A. Base Caps: Zinc with projecting base of 1/8 inch; _____ color.
- B. Cant Strips: Molded of flooring resin material.
- C. Crack Isolation: Manufacturer's recommended urethane elastomer membrane for protecting fluid-applied floor system against cracking.
- D. Joint Control: Manufacturer's recommended polyurethane sealant and backer rod to limit damage from moving joints in the floor.
- E. Subfloor Filler: Type recommended by fluid-applied flooring manufacturer.
- F. Primer: Type recommended by fluid-applied flooring manufacturer.
- G. Moisture Vapor Treatment: Where fluid-applied flooring and accessories are installed over concrete slabs, provide alkaline-resistant product designed to control excessive moisture vapor transmission through concrete slab, per the following:
 - 1. Products: Provide product approved by flooring manufacturer and complying with performance requirements below, equivalent to one of the following:
 - a. Duraamen Engineered Products, Inc.; Perdure MVT.
 - b. Maxxon Corporation; Maxxon MVP.
 - c. Tnemec Company Inc.; Epoxoprime MVT, Series 208.
 - 2. Performance Requirements:
 - a. Verify with flooring manufacturer that submitted product maintains compliance with all provisions of flooring manufacturer's warranty.
 - b. Low-VOC: Provide product with VOC content less than 15 g/L.
 - c. Bond Strength to Concrete: Minimum 400 psi per ASTM D 4541 (100% concrete failure).
 - d. Permeance: Maximum 0.1 perm per ASTM E 96, and 0.10 grains/hr/ft²/in-Hg, per ASTM F3010.
 - e. Applications: Provide MVT for all concrete slabs on-grade and lightweight concrete elevated slabs.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive flooring.
- B. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of materials to subfloor surfaces.
- C. Cementitious Subfloor Surfaces: Install manufacturer's recommended moisture vapor treatment at all locations to receive fluid-applied floor finish in accordance with manufacturer's instructions; moisture vapor treatment at fluid-applied flooring is not subject to MVT unit price or allowance specified in other sections.
- D. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

- A. Remove subfloor ridges and bumps. Fill low spots, cracks, joints, holes, and other defects with subfloor filler.
- B. Prepare concrete surfaces according to ICRI 310.2R, CSP 4, minimum, unless otherwise required by manufacturer's installation requirements.
- C. Apply crack isolation compound to concrete slab in accordance with flooring manufacturer's instructions.
- D. Apply, trowel, and float filler to achieve smooth, flat, hard floor surface. Grind irregularities above the surface level. Prohibit traffic until filler is cured.
- E. Vacuum clean substrate.
- F. Apply primer to surfaces required by flooring manufacturer.

3.03 INSTALLATION - ACCESSORIES

- A. Install cant strips at base of walls where flooring is to be extended up wall as base.
- B. Install joint control sealant and backer rod where indicated on Drawings in accordance with flooring manufacturer's instructions.
- C. Install terminating cap strip at top of base; attach securely to wall substrate.

3.04 INSTALLATION - FLOORING

- A. Apply in accordance with manufacturer's instructions.
- B. Apply each coat to minimum thickness required by manufacturer.
- C. Finish to smooth level surface.
- D. Install flooring to the center of cased openings, and into door openings such that the transition to other floor material occurs under the center of the door leaf. Where transitions occur to another flooring material, extend resinous flooring to suit transition.
- E. Cove at vertical surfaces and cap with metal base trim.

3.05 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Provide services of manufacturer's technical representative to inspect for proper installation of fluid-applied flooring system and submit inspection report.

3.06 PROTECTION

- A. Prohibit traffic on floor finish for minimum 48 hours after installation.
- B. Barricade area to protect flooring until fully cured.

END OF SECTION 096700

**SECTION 096813
TILE CARPETING**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
- B. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
- C. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
- D. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
- E. ILFI (DEC) - International Living Future Institute 'Declare' Program.
- F. CRI (GLP) - Green Label Plus Testing Program - Certified Products.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Substitutions/Prequalification: Manufacturers seeking consideration to bid their product as an acceptable alternative shall provide full product data and full range of selection samples during the bid period. Products that do not meet the technical and aesthetic criteria will not be accepted. No substitutions shall be permitted for carpet tile after receipt of bids.

1.03 SUBMITTALS

- A. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- B. Shop Drawings: Indicate layout of joints, direction of carpet pile, dye lot, and location of edge moldings and transition strips.
 - 1. Where multiple carpet tile products are specified (including multiple products in a single space installed in an indicated pattern), indicate on the shop drawings the locations where each product is being installed.
- C. Selection Samples: Submit manufacturer's color charts indicating full range of colors for carpet tiles and for accessories.
- D. Verification Sample: Submit full size sample for each required color, pattern, and texture.
 - 1. Submit samples in manufacturer's standard size for each accessory product.
- E. Sustainable Design Submittal: Submit VOC content documentation for adhesives.
- F. Sustainable Design Submittal: Submit a copy of ILFI (DEC) Declare Label for each product.
- G. Operation and Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.
 - 1. Include specific procedures and materials that are not recommended, including those that may be harmful to carpet tile or that would void warranty.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

1.04 QUALITY ASSURANCE

- A. Critical Radiant Flux: All carpet tiles shall be Class I rated, with a minimum CRF of 0.45 watts/sq cm, when tested by an independent testing agency in accordance with ASTM E648 or NFPA 253.

1.05 FIELD CONDITIONS, STORAGE AND HANDLING

- A. Comply with the Carpet and Rug Institute (CRI) Publication "CRI 104 - Standard for Installation of Commercial Carpet." Comply with Section 4.0 for storage and handling, Section 7.0 for ambient temperature and ventilation, and Section 9.0 for Product Acclimation.

1.06 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Carpet Tile Warranty: Provide a ten (10) year manufacturer warranty, covering defective material and faulty installation.
 - 1. Warranty shall cover excessive surface wear (defined as more than 10% loss by weight of face fiber), edge raveling, backing separation, shrinking, stretching, cupping, doming, static electricity, or color loss or fading.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Tile Carpeting: Provide the basis-of-design carpet tiles or a prequalified comparable tile approved by Architect. No substitutions will be considered after the award of Contract.
 - 1. Mohawk (basis-of-design).
 - 2. Mannington Commercial.
 - 3. Patcraft.
 - 4. Shaw Contract.

2.02 MATERIALS

- A. Tile Carpeting, Type C-TILE: Tufted, manufactured in one color dye lot.
 - 1. Basis-of-Design Product: Shifted Focus manufactured by Mohawk.
 - 2. Tile Size: 18 by 18 inch, nominal.
 - a. Fiber: Type 6,6 nylon or Type 6 cationic nylon.
 - 3. Critical Radiant Flux: Minimum of 0.45 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
 - 4. Sustainability Requirement: Provide ILFI (DEC) certified Red-List Free product.
 - 5. VOC Content: Provide CRI (GLP) certified product; in lieu of labeling, independent test report showing compliance is acceptable.
 - 6. Primary Backing Material: Manufacturer's standard; recycled vinyl with fiberglass reinforcing.

2.03 ACCESSORIES

- A. Subfloor Filler: Type recommended by flooring material manufacturer.
- B. Edge Strips: Rubber, color as selected by Architect.
- C. Moisture Vapor Treatment (MVT): Where carpeting and accessories are installed over concrete slabs, and where concrete testing indicates high moisture content levels, provide alkaline-

resistant product designed to control excessive moisture vapor transmission through concrete slab, in accordance with quantity allowance and unit price requirements and per the following:

1. Products: Provide product approved by flooring manufacturer and complying with performance requirements below, equivalent to one of the following:
 - a. Duraamen Engineered Products, Inc.; Perdure MVT.
 - b. Maxxon Corporation; Maxxon MVP.
 - c. Tnemec Company Inc.; Epoxoprime MVT, Series 208.
 2. Performance Requirements:
 - a. Verify with flooring manufacturer that submitted product maintains compliance with all provisions of flooring manufacturer's warranty.
 - b. Low-VOC: Provide product with VOC content less than 15 g/L.
 - c. Bond Strength to Concrete: Minimum 400 psi per ASTM D 4541 (100% concrete failure).
 - d. Permeance: Maximum 0.1 perm per ASTM E 96, and 0.10 grains/hr/ft²/in-Hg, per ASTM F3010.
 - e. Applications: Provide MVT for all concrete slabs on-grade and lightweight concrete elevated slabs.
- D. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; releasable type.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.
- B. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.
- C. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
 1. Test as Follows: Perform one of each test per 1,000 sf of installation area.
 - a. Alkalinity (pH): ASTM F710.
 - b. Internal Relative Humidity: ASTM F2170.
 - c. Moisture Vapor Emission: ASTM F1869.
 2. If test results are not within limits recommended by flooring manufacturer, apply moisture vapor treatment (MVT) in accordance with manufacturer's requirements. MVT shall be provided per unit price and quantity allowance requirements.
- D. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- B. Remove subfloor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with subfloor filler.
- C. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.

3.03 INSTALLATION

- A. Starting installation constitutes acceptance of subfloor conditions.

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- B. Install carpet tile in accordance with manufacturer's instructions and CRI 104 (Commercial).
- C. To ensure minimal color variation, ensure that each space/room uses only carpet from the same dye lot.
- D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
- E. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines, unless otherwise indicated.
- F. Locate change of color or pattern between rooms or at transitions to other finish flooring material directly under the door leaf centerlines, or at the center of cased openings.
- G. Fully adhere carpet tile to substrate.
- H. Install carpet tile into wall recesses, knee spaces under cabinets or countertops, closets, and other similar spaces.
- I. Trim carpet tile neatly at walls and around interruptions.
- J. Complete installation of edge strips, concealing exposed edges.

3.04 CLEANING AND PROTECTION

- A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
- B. Clean and vacuum carpet surfaces.
- C. Protect installed carpet in accordance with CRI 104, Section 13.7 "Post Installation."

END OF SECTION 096813

SECTION 098430
SOUND-ABSORBING WALL AND CEILING UNITS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
- B. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- D. ASTM E795 - Standard Practices for Mounting Test Specimens during Sound Absorption Tests.

1.02 SUBMITTALS

- A. Product Data: Manufacturer's printed data sheets for products specified.
- B. Shop Drawings: Fabrication and installation details, panel layout, fabric orientation, and wood grain orientation.
- C. Selection Samples: Manufacturer's color charts for fabric covering, indicating full range of fabrics, colors, and patterns available.
- D. Test Reports: Certified test data from an independent test agency verifying that panels meet specified requirements for acoustical and fire performance.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Protect acoustical units from moisture during shipment, storage, and handling. Deliver in factory-wrapped bundles; do not open bundles until units are needed for installation.
- B. Store units flat, in dry, well-ventilated space; do not stand on end.
- C. Protect edges from damage.

1.04 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a two-year period for failure of materials or workmanship commencing on the Date of Substantial Completion.
 - 1. Failures include but are not limited to acoustic performance, fabric separation from core or fabric sagging, panel distortion or warping.

PART 2 PRODUCTS

2.01 WOOD FIBER SOUND-ABSORBING UNITS

- A. Manufacturers:
 - 1. Armstrong World Industries, Inc; Tectum Direct-Attach.
 - 2. Cardinal Acoustics; Direct Attached Panel.
 - 3. Conwed; Arborcoustic.
 - 4. Troy Acoustics Corporation; Troy Board.
 - 5. Substitutions: See Section 016000 - Product Requirements.
- B. Wood Fiber Acoustical Panels for Walls: Cementitious wood fiber.
 - 1. Size: 24 by 24 inches.

2. Thickness: 1 inch.
3. Noise Reduction Coefficient (NRC): 0.80 minimum when tested in accordance with ASTM C423 for Type C-20 mounting, per ASTM E795.
4. Panel Edge: Beveled.
5. Surface Pattern: Coarse.
6. Surface Color: Manufacturer's standard; panels shall be field-painted.
7. Installation Method (Wall): Direct-attached over 1 inch depth furring strips and 3 lb rigid/semi-rigid glass fiber acoustic board.
 - a. Furring Strips: 1 inch depth wood furring.
 - b. Fiberboard Insulation: Rigid/semi-rigid mineral fiber, ASTM C612, unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.

2.02 FABRICATION

- A. Tolerances: Fabricate to finished tolerance of plus or minus 1/16 inch for thickness, overall length and width, and squareness from corner to corner.

2.03 ACCESSORIES

- A. Back-Mounting Accessories: Manufacturer's standard accessories for concealed support, designed to allow panel removal, and as follows:
 1. Two-part clip and base-support bracket system; brackets designed to support full weight of panels and clips designed for lateral support, with one part mechanically attached to back of panel and the other attached to substrate.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates for conditions detrimental to installation of acoustical units. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install acoustical units in locations as indicated, following manufacturer's installation instructions.
- B. Install mounting accessories and supports in accordance with shop drawings.
- C. Align panels accurately, with edges plumb and top edges level. Scribe to fit accurately at adjoining work and penetrations.
- D. Install acoustical units to construction tolerances of plus or minus 1/16 inch for the following:
 1. Plumb and level.
 2. Flatness.

3.03 CLEANING

- A. Clean sound-absorptive panels upon completion of installation from dust and other foreign materials, following manufacturer's instructions.

3.04 PROTECTION

- A. Provide protection of installed acoustical panels until Date of Substantial Completion.

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- B. Replace panels that cannot be cleaned and repaired to satisfaction of the Architect.

END OF SECTION 098430

**SECTION 099100
PAINTING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Finish exterior and interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated. Specific items include (but are not limited to) the following:
 - 1. Fire- and Smoke-Rated Wall Identification: Permanently label fire- and smoke-rated walls, partitions, and barriers per requirements of applicable building code. Labeling shall include fire-resistance rating, type of assembly, and instruction to protect openings/penetrations. Example text: "ONE HOUR FIRE BARRIER - PROTECT ALL OPENINGS".
 - a. Locate lettering in concealed accessible floor, floor-ceiling plenums, and attic spaces, located no more than 15 feet from end of wall and at horizontal intervals not exceeding 30 feet, with stenciled lettering not less than 3 inches high with minimum 3/8-inch strokes. Locate directly inside of access doors or panels that provide access to rated walls. Do not paint walls where exposed to view except in support spaces (mechanical / electrical rooms and similar spaces).
 - 2. Refer to the life safety plans and partition schedule on the drawings for rated wall and partition locations.
 - 3. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
 - 4. Elevator pit ladders.
 - 5. Prime surfaces to receive wall coverings.
 - 6. Mechanical and Electrical:
 - a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
 - b. Paint dampers exposed behind louvers, grilles, and convectors and baseboard cabinets to match face panels.
 - 7. Shop-Primed Items: In finished areas, paint shop-primed items. Unless specifically indicated that additional field primer is not required, provide a tie coat primer over the shop primer before top coat(s) are applied.
- D. Do Not Paint or Finish the Following Items:
 - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
 - 5. Stainless steel, anodized aluminum, bronze, terne-coated stainless steel, and lead items.
 - 6. Marble, granite, slate, and other natural stones.
 - 7. Floors, unless specifically indicated.
 - 8. Ceramic and other tiles.

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9. Brick, architectural concrete, architectural precast, cast stone, and integrally colored plaster, fiberglass, or stucco.
10. Glass.
11. Acoustical materials, unless specifically indicated.
12. Concealed pipes, ducts, and conduits.

1.02 REFERENCE STANDARDS

- A. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.
- B. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual.
- C. SSPC-SP 1 - Solvent Cleaning.
- D. SSPC-SP 6 - Commercial Blast Cleaning.

1.03 SUBMITTALS

- A. Product Data: Provide complete list of products to be used, with the following information for each:
 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g., "alkyd enamel").
 2. Cross-reference to specified paint system(s) product is to be used in; include description of each system.

1.04 DELIVERY, STORAGE, AND HANDLING

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

1.05 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply materials when relative humidity exceeds 85 percent, at temperatures less than 5 degrees F above the dew point, or to damp or wet surfaces.
- D. Minimum Application Temperatures for Paints: 50 degrees F for interiors unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Paints:
 1. Benjamin Moore.
 2. PPG Paints.

3. Sherwin-Williams Company.

2.02 PAINTS AND FINISHES - GENERAL

- A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.
 - 1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 - 2. Supply each paint material in quantity required to complete entire project's work from a single production run.
 - 3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B. Low-Emitting Materials (Paints and Coatings): Paints and coatings field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with CAL (CDPH SM) AND shall meet applicable VOC limits of CARB (SCM) or SCAQMD 1113.

2.03 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.
- D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:
 - 1. Gypsum Wallboard: 12 percent.

3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or repair existing paints or finishes that exhibit surface defects.
- D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- E. Seal surfaces that might cause bleed through or staining of topcoat.
- F. Concrete:
 - 1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
- G. Masonry:

1. Remove efflorescence and chalk. Do not coat surfaces if moisture content, alkalinity of surfaces, or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
- H. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
- I. Galvanized Surfaces:
 1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
- J. Ferrous Metal:
 1. Solvent clean according to SSPC-SP 1.
 2. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.

3.03 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- C. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
- D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- E. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
- F. Sand wood and metal surfaces lightly between coats to achieve required finish.
- G. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- H. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

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

3.05 PROTECTION

- A. Protect finishes until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

3.06 EXTERIOR PAINT SCHEDULE

- A. General: Provide the following Paint systems for the various substrates, as indicated. Dry film thickness is noted as "DFT." Provide compatibility test areas on existing painted substrates.
- B. Zinc-Coated or Zinc-rich Primer-Coated Metal with Direct to Metal ("DTM") Gloss Acrylic Enamel Finish: 2 topcoats of DTM gloss enamel over primer, with min. total DFT of 2.5 mils.
 1. Prime Coat (Tie-Coat): Lead-free, acrylic base interior/exterior galvanized metal primer, premium grade. Apply over shop primer.
 - a. Moore: HP04 Ultra Spec HP Acrylic Metal Primer.
 - b. PPG: 90-1908 Pitt-Tech Plus EP Acrylic Primer/Finish.
 - c. S-W: B66W1310 Pro Industrial Pro-Cryl Universal Acrylic Primer.

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2. First and Second Coats: DTM Acrylic Gloss Enamel.
 - a. Moore: HP28 Ultra Spec HP Acrylic Gloss Enamel.
 - b. PPG: 90-1510 Pitt-Tech Plus EP DTM Acrylic Gloss.
 - c. S-W: B66W1051 Pro Industrial DTM Acrylic Coating (Gloss).
- C. Field-Applied Coatings for Ferrous Metal (AESS): Aliphatic urethane system of intermediate coat and topcoat. Provide scheduled products for exposed steel fabrications indicated as AESS.
 1. Field Touch-up: Match moisture curing urethane zinc-rich shop primer.
 2. Intermediate Coat: Moisture curing urethane and micaceous iron oxide or epoxy.
 - a. Moore: Corotech V160 Epoxy Mastic Coating.
 - b. PPG: PMC Amerlock 600.
 - c. S-W: Macropoxy 646 Fast Cure Epoxy, B58-600/B58v600.
 3. Top Coat: Aliphatic urethane at 2.0 – 3.0 mils DFT.
 - a. Moore: Corotech V500 Aliphatic Acrylic Urethane.
 - b. PPG: 95-812 Pitthane Ultra Gloss Urethane Enamel.
 - c. S-W: Corothane I Aliphatic Finish Coat B65.
- D. Coatings to Repaint Exterior Ferrous Metal: Aliphatic urethane topcoat system over surface-tolerant epoxy mastic. Provide to repaint existing exposed steel fabrications with extended weather exposure deterioration and surface rust.
 1. Preparation: Clean steel to SSPC SP-3 Power Tool Cleaning to remove all rust scale, mill scale and loose rust, oil, grease and other contaminants.
 2. Primer: Surface-tolerant fast curing polyamide epoxy (mastic). 5.0 – 10.0 mils DFT.
 - a. Moore: P45 Mastic Epoxy Gloss Coating.
 - b. PPG: PMC Amerlock 600.
 - c. S-W: Macropoxy 646 Fast Cure Epoxy.
 3. First and Second Top Coats: Aliphatic urethane at 3.0 – 4.0 mils DFT per coat
 - a. Moore: P74 Aliphatic Acrylic Urethane.
 - b. PPG: 95-8930 Pitthane Ultra LS.
 - c. S-W: B65-300 Series / B60V30 Hi-Solids Polyurethane.
- E. Concrete: Acrylic latex satin finish, two finish coats over alkali-resistant primer with minimum total DFT of not less than 3.5 mils.
 1. Prime Coat: Exterior Acrylic weathered masonry sealer/primer.
 - a. Moore: 608 Ultra Spec Masonry Int/Ext 100% Acrylic Sealer/Primer.
 - b. PPG: 4-603 Perma-Crete Int/Ext Alkali Resistant Primer.
 - c. S-W: A24w8300, Loxon Concrete & Masonry Primer.
 2. First and Second Finish Coats: Exterior 100% Acrylic – Satin sheen; premium grade.
 - a. Moore: N401 Regal Select Exterior Paint High Build Low Lustre Finish.
 - b. PPG: 76-45 Sun-Proof Ext House & Trim, Satin.
 - c. S-W: A82 Series A-100 Exterior Latex Satin.
- F. Concrete Masonry Units: Acrylic latex satin finish, two finish coats over primer with minimum total DFT of not less than 3.5 mils.
 1. Prime Coat: Exterior Acrylic weathered masonry sealer/primer.
 - a. Moore: 571 Ultra Spec Hi-Build Masonry Block Filler.
 - b. PPG: 6-15 Speedhide Int/Ext Acrylic Masonry Block Filler.

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- c. S-W: A24W200 Loxon Block Surfacers.
- 2. First and Second Finish Coats: Exterior 100% Acrylic – Satin sheen; premium grade.
 - a. Moore: N401 Regal Select Exterior Paint High Build Low Lustre Finish.
 - b. PPG: 76-45 Sun-Proof Ext House & Trim, Satin.
 - c. S-W: A 82 Series A-100 Exterior Latex Satin.
- G. Exterior Gypsum Soffit Board with Smooth Finish 100% Acrylic Coating: Top coat(s) for total DFT of 10.0 mils minimum over primer-sealer.
 - 1. Prime Coat (Tie-Coat): Bonding primer-sealer.
 - a. Moore: N023 Fresh Start All Purpose 100% Acrylic Int/Ex Latex Primer.
 - b. PPG: 17-921 Seal-Grip Gripper Interior/Exterior 100% Acrylic Latex Primer.
 - c. S-W: B51-450, Multi-Purpose Primer.
 - 2. First and Second Finish Coats: Exterior 100% Acrylic – Flat finish; premium grade.
 - a. Moore: N400 Regal Select Exterior Paint High Build Flat Finish.
 - b. PPG: 72-45 Sun-Proof Ext House & Trim. Flat Latex 100% Acrylic
 - c. S-W: A6 Series A-100 Exterior Latex Flat
- H. General Painted Wood and Plywood with Acrylic Latex Satin Finish: 2 finish coats over primer with total DFT not less than 3.5 mils.
 - 1. Prime Coat: Alkyd-based wood sealer/primer.
 - a. Ben Moore: 024 Fresh Start Multi-Purpose Oil Based Primer.
 - b. PPG: 17-941 Seal-Grip Interior/Exterior Alkyd Universal Primer.
 - c. S-W: Y24W8020 Exterior Oil Wood Primer.
 - 2. First and Second Finish Coats: Exterior 100% Acrylic – Satin sheen; premium grade.
 - a. Moore: N401 Regal Select Exterior Paint High Build Low Lustre Finish.
 - b. PPG: 76-45 Sun-Proof Ext House & Trim, Satin.
 - c. S-W: A82 Series A-100 Exterior Latex Satin.
- I. Exterior Wood Dumpster Enclosure Siding and Trim with Solid Color Latex-Emulsion Stain: 2 Finish coats.
 - 1. Stain Coat: Acrylic latex solid color stain.
 - a. Moore: 610 ArborCoat Exterior Stain - Solid Ultra Flat.
 - b. Cabot: Cabot O.V.T. Solid Color Acrylic Stain.
 - c. PPG: FLD820, Flood Solid Color 100% Acrylic Latex Base Stain.
 - d. S-W: A16, Woodscapes Exterior Solid Acrylic Stain.

3.07 INTERIOR PAINT SCHEDULE

- A. General: Provide the following paint systems for the various substrates, as indicated. Dry film thickness is noted as "DFT." Provide compatibility test areas on existing painted substrates.
- B. Concrete Masonry Units: Low-VOC Acrylic Satin Finish. 2 Coats over filler, with total DFT not less than 2.5 mils. (Provide for CMU except where "epoxy finish" is indicated.)
 - 1. Filler Coat, 100% Acrylic. Apply filler coat at a rate to ensure complete coverage. Brush, spray or roller apply and back roll or squeegee for smooth, pinhole-free treatment.
 - a. Moore: 571 Ultra Spec Hi-Build Masonry Block Filler.
 - b. PPG: 16-90 Pitt Glaze WB Acrylic Interior Exterior Block Filler.
 - c. S-W: B46W150 Pro Industrial Heavy Duty Block Filler. (PrepRite not acceptable)

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2. Waterproofing Filler Coat – Showers & Wet Applications: Cementitious resin or epoxy block filler applied by brush, spray or roller and back rolled or squeegeed for smooth, pinhole-free treatment.
 - a. Moore: P31 Waterborne Epoxy Block filler.
 - b. PPG: 95-217 Epoxy Ester Cementitious Waterproofing Block Filler.
 - c. S-W: B42W400/B42V401 Kem Cati-Coat HS Epoxy Filler/Sealer.
 3. Bonding Primer (previously painted): Acrylic bonding primer for exceptional adhesion to hard, glossy surfaces. Test for adhesion. Brush, spray or roller apply and back roll.
 - a. Moore: Stix Bonding Primer.
 - b. PPG: 17-921 PPG Seal Grip Acrylic Universal Primer/Sealer.
 - c. S-W: B51W150 Extreme Bond Interior/Exterior Primer.
 4. First & Second Finish Coats: Commercial Interior Low-VOC Acrylic Satin Finish. Provide for wall finishes unless directed otherwise.
 - a. Moore: N538 Ultra Spec 500 Interior Eggshell Finish.
 - b. PPG: 6-411ZV Speedhide Interior Eggshell Latex.
 - c. S-W: B20-12650 ProMar 200 Zero VOC Interior Latex Eg-Shel.
- C. Concrete Masonry Units - Semi-Gloss Water-Borne Epoxy Finish: 2 Coats over filler:
1. Block Filler Coat: Acrylic-latex or as required by manufacturer for topcoat. Brush, spray or roller apply and back roll for smooth pinhole-free treatment.
 - a. Moore: 571 Ultra Spec Hi-Build Masonry Block Filler.
 - b. PPG: 6-15 Speedhide Int/Ext Acrylic Masonry Block Filler.
 - c. PPG: 16-90 Pitt-Glaze WB Int/Ext Block Filler Latex.
 - d. S-W: B46W150 Pro Industrial Heavy Duty Block Filler.
 2. First and Second Coats: Two-component, semi-gloss water born polyamide epoxy enamel applied at a DFT of 1.5 to 4.0 mils per coat.
 - a. Moore: Corotech V400 Polyamide Epoxy Coating.
 - b. PPG: 98E-xx Base / 98E-100 Aquapon WB EP Water Based Epoxy – Semi-Gloss.
 - c. S-W: B73W360 / B73V300 Pro Industrial Water Based Catalyzed Epoxy.
- D. Concrete Floor with Gloss Water-Base Epoxy Floor Enamel: 2 Coats over primer on cured surface. Concrete must cure a minimum of 30 days before painting and have pH of 10.0 or lower. Prepare per SSPC-SP13, shot blast or prepare floor by other means acceptable to paint manufacturer (accepted in writing) prior to painting.
1. Primer Coat: Epoxy primer, brush or roller applied over prepared concrete. Provide 1.5 - 2.0 mils DFT per coat or as recommended by manufacturer.
 - a. Moore: P41 Fast Dry Epoxy Floor Sealer/Finish.
 - b. PPG: 98E-1 Series Aquapon WB EP Water Base Epoxy 2.0 mils to 3.0 mils DFT per coat.
 - c. S-W: B70-8100/B70V8100 Armorseal 8100 Water based Epoxy Floor Coating.
 2. Two Finish Coats: Two-component waterborne catalyzed polyamide epoxy floor enamel or comparable performance enamel. Provide 1.5 - 2.0 mils DFT per coat or as recommended by manufacturer.
 - a. Moore: P42 Waterborne Polyamide High Gloss Epoxy Enamel 2.0 mils to 3.0 mils DFT per coat.
 - b. PPG: 98E-1 Series Aquapon WB EP Water Base Epoxy 2.0 mils to 3.0 mils DFT per coat.
 - c. S-W: B70-8100/B70V8100 Armorseal 8100 Water based Epoxy Floor Coating.

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- E. Gypsum Board Systems with Latex Finish: Satin (egg-shell) finish at walls and flat finish on ceilings except as indicated otherwise. Provide best commercial Zero-VOC formulation with 0 VOC per EPA test method 24.
1. Filler Coat: 0 VOC (per EPS test method 24) Latex Primer.
 - a. Moore: N534 Ultra Spec 500 Interior Latex Primer.
 - b. PPG: 9-900 Pure Performance Interior Latex Primer.
 - c. S-W: B28-2600 ProMar 200 Zero VOC Interior Latex Primer.
 2. First & Second Finish Coats: Interior Zero-VOC Acrylic Satin Finish. (Low lustre/Satin = 25-45% @60°) Provide for wall finishes unless indicated otherwise.
 - a. Moore: N538 Ultra Spec 500 Interior Eggshell.
 - b. PPG: 6-411ZV Speedhide Interior Eggshell Latex.
 - c. S-W: B20-12650 ProMar 200 Zero VOC Interior Latex Eg-Shel.
 3. First & Second Finish Coats: Interior Zero-VOC Acrylic Flat Finish. Provide for ceiling applications unless indicated otherwise.
 - a. Moore: N536 Ultra Spec 500 Interior Flat.
 - b. PPG: 6-70ZV Speedhide Interior Latex Flat.
 - c. S-W: B30-2600 ProMar 200 Zero VOC Interior Latex Flat or B30-4650 ProMar 400 Zero VOC Interior Latex Flat.
- F. Gypsum Board Systems with Water-Borne Polyamide Epoxy Finish ("EPX"):
1. Filler Coat: Manufacturer's recommended primer.
 - a. Moore: 217 Fresh Start Alkyd Enamel Underbody.
 - b. PPG: 6-2 Speedhide Interior Latex Sealer.
 - c. S-W: B28W2600 ProMar 200 Zero VOC Primer.
 2. First and Second Coats: Two-component, water born polyamide epoxy enamel applied at a DFT of 1.5 to 4.0 mils per coat. Provide semi-gloss finish unless directed otherwise.
 - a. Moore: Corotech V440 Waterborne Amine Epoxy.
 - b. PPG: 98E-xx Base / 98E-100 Aquapon WB EP Water Based Epoxy – Semi-Gloss.
 - c. S-W: B73W360 / B73V300 Water Based Catalyzed Epoxy.
- G. Ferrous Metal with Latex Dry Fog Finish: One finish coat over primed exposed construction. Provide nominal 50 square foot sample area to test for paint compatibility with substrates.
1. Prime Coat: (Acrylic or recommended VOC-compliant metal primer for surfaces not pre-primed.) 2.0 mils DFT.
 - a. Moore: N110 Superkote 5000 DryFall Latex Flat.
 - b. PPG: 90-1908 Pitt-Tech Plus EP Acrylic Primer/Finish.
 - c. S-W: B66-1300 Series Pro Industrial Pro-Cryl Universal Acrylic Primer.
 2. Top Coat: All exposed structure as scheduled. Acrylic Dry Fog 3.0 mils DFT. Provide color finish as selected by Architect from manufacturer's full range.
 - a. Moore: N110 Superkote 5000 DryFall Latex Flat.
 - b. PPG: 6-725XI Speedhide Super Tech WB Int. Dry-Fog Flat Latex Flat.
 - c. S-W: B42W1181 / B42B81 Waterborne Acrylic Dry Fall, Flat.
- H. Ferrous Metal: Direct to Metal ("DTM") Acrylic Enamel Finish: 2 Coats over primer, with total DFT not less than 2.5 mils. Provide satin finish at hollow metal steel doors and frames, and semi-gloss at other applications.
1. Prime Coat: Lead-free, acrylic base primer. Not required on shop primed items.
 - a. Moore: HP29 Ultra Spec HP DTM Acrylic Semi-Gloss.

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- b. PPG: 90-1908 Pitt-Tech Plus EP Acrylic Primer/Finish.
 - c. S-W: B66W11 Pro Industrial DTM Acrylic Primer/Finish (or B66 W200).
- 2. Bonding Primer (previously painted): Acrylic bonding primer designed for previously painted ferrous metal to ensure secure bond. Brush, spray or roller apply and back roll.
 - a. Moore: SXA-110 Insl-X Waterborne Bonding Primer.
 - b. PPG: 90-1908 Pitt-Tech Plus EP Acrylic Primer/Finish.
 - c. S-W: B66A50 DTM Bonding Primer.
- 3. First and Second Coat: DTM Acrylic Semi-Gloss Enamel. (30-40 units @ 60°)
 - a. Moore: HP29 Ultra Spec HP DTM Acrylic Semi-Gloss.
 - b. PPG: 90-1610 Pitt-Tech Plus EP DTM Acrylic Semi-Gloss.
 - c. S-W: B66W1151 Pro Industrial DTM Acrylic Semi-Gloss Coating.
- 4. First and Second Coat: DTM Acrylic Satin Enamel. Provide for hollow metal steel doors and frames. (15-25 units @ 60°)
 - a. Moore: HP25 Ultra Spec HP DTM Acrylic Low Lustre.
 - b. PPG: 90-1710 Pitt-Tech Plus EP DTM Acrylic Satin.
 - c. S-W: B66W1251 Pro Industrial DTM Acrylic Eg-Shel.
- I. Zinc-Coated Metal: Semi-Gloss Direct to Metal ("DTM") Acrylic Enamel Finish: 2 Coats over primer, with min. total DFT of 2.5 mils.
 - 1. Prime Coat: Lead-free, acrylic base interior galvanized metal primer, premium grade.
 - a. Moore: HP04 Ultra Spec HP Acrylic Metal Primer.
 - b. PPG: 90-1908 Pitt-Tech Plus EP Acrylic Primer/Finish.
 - c. S-W: B66W1151 Pro Industrial DTM Acrylic Semi-Gloss Coating.
 - 2. First and Second Coats: DTM Acrylic Semi-Gloss Enamel. Same as for ferrous metal.

END OF SECTION 099100

**SECTION 101400
SIGNAGE**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines.
- B. ADA Standards - 2010 ADA Standards for Accessible Design.
- C. ICC A117.1 - Accessible and Usable Buildings and Facilities.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Allowance: Interior and exterior panel signage shall be covered by allowance; refer to Section 012100 - Allowances.
- B. Pre-Fabrication Meeting: The signage contractor shall meet with representatives of the Owner to develop a Signage Schedule, including signage style and layout, individual sign locations, including locations of code required signage and wayfinding signage, and final room naming and numbering. The Architect will provide the graphics contractor with reproducible floor plan drawings for use in determining sign locations.

1.03 SUBMITTALS

- A. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
- B. Signage Schedule (After Pre-Fabrication Meeting): Submit schedule with information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
 - 1. Submit for approval by Owner through Architect prior to fabrication.
- C. Selection Samples: Where colors are not specified, submit color selection charts or chips for each type of signage.
- D. Verification Samples: Submit samples, manufacturer's standard size, showing selected colors for each type of signage.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Package signs as required to prevent damage before installation.
- B. Package room and door signs in sequential order of installation, labeled by floor or building.
- C. Store tape adhesive at normal room temperature.

1.05 FIELD CONDITIONS

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.01 SIGNAGE APPLICATIONS

- A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
- B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
 - 1. Sign Type: Flat signs with engraved panel media as specified.
 - 2. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
 - 3. Toilet room signage shall include pictograms and international symbol of accessibility.

2.02 PANEL SIGNAGE TYPES

- A. General: Interior and exterior panel signage shall be provided via lump-sum allowance; refer to Division 1 Section "Allowances."
- B. Manufacturers:
 - 1. Allen Industries Architectural Signage.
 - 2. APCO Graphics, Inc.
 - 3. ASI-Modulex, Inc.
 - 4. Best Sign Systems, Inc.
 - 5. Gemini Incorporated.
 - 6. Innerface Sign Systems, Inc.
 - 7. InPro Corporation.
 - 8. Matthews International Corporation, Bronze Division.
 - 9. Mohawk Sign Systems.
 - 10. Nelson-Harkins Industries.
 - 11. Seton Identification Products.
 - 12. The Supersine Company.
 - 13. Welch Sign.
 - 14. Worth Higgins and Associates.
 - 15. Substitutions: See Section 016000 - Product Requirements.
- C. Photopolymer Panel Signage: Signage media without frame.
 - 1. Signage Material: 0.032-inch water wash photopolymer face layer over a 0.160-inch phenolic or 0.120-inch PETG base layer.
 - 2. Edges: Square.
 - 3. Corners: Square.
 - 4. Wall Mounting of One-Sided Signs: Tape adhesive.
 - a. For signs mounted to glass, such as at door sidelights, provide a rear cover plate so the backside of sign will not be visible through the glass.
 - 5. Tactile Signage: Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
- D. Aluminum Panel Signage: Fabricate of minimum 0.063-inch aluminum sheet, without frame, with baked enamel finish. Wall mount with stainless steel fasteners in each corner. Not acceptable at locations requiring tactile signage.

- E. Color and Font: Unless otherwise indicated, panel signage, font, and color shall be selected from manufacturer's full range.
- F. Code-Required Signage: In addition to the room signage, provide panel signage required by accessibility regulations and requirements of authorities having jurisdiction, including, but not limited to, the following:
 - 1. Tactile exit signs, stairway identification signs, room maximum capacity signs, elevator signs, and accessible space signs.
 - 2. Refer to Division 26 and Electrical Drawings for illuminated exit signs.

2.03 ACCESSORIES

- A. Concealed Screws: Stainless steel, or other non-corroding metal.
- B. Tape Adhesive: Double sided tape, permanent adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install neatly, with horizontal edges level.
- C. Locate signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.
 - 1. Room Signs: Mount on latch side, with a clear space of 18 inches by 18 inches beyond the door swing arc, centered on the tactile characters. At double doors, mount to the right of right-hand leaf or on nearest adjacent wall. Mount at height that is compliant with ADA Standards.
- D. Protect from damage until Date of Substantial Completion; repair or replace damaged items.

END OF SECTION 101400

SECTION 102113.19
HDPE TOILET/SHOWER PARTITIONS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings where required.

1.03 SUBMITTALS

- A. Product Data: Provide data on panel construction, hardware, and accessories.
 - 1. Provide data for wall anchors for attachment of wall brackets.
 - 2. Provide data substantiating that door latch product complies with accessibility standards.
 - 3. Provide data indicating NFPA 286 testing and compliance.
- B. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.
 - 1. Include locations of plumbing fixtures and floor drains.
 - 2. Include accessible and ambulatory stalls, including stall and door clearances.
- C. Selection Samples: Submit color charts indicating manufacturer's full range of colors. Color charts shall indicate which colors are NFPA 286 compliant.
- D. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods. Describe cleaning materials detrimental to finish surfaces and hardware finish.
- E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.04 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide 15 year manufacturer warranty against defects in material and workmanship, excluding abuse.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: Provide HDPE panels tested per NFPA 286 and shown to meet the following criteria:
 - 1. During the 40 kW exposure, flames shall not spread to the ceiling.
 - 2. During the 160 kW exposure:
 - a. Flame shall not spread to the outer extremity of the sample on any wall or ceiling.
 - b. Flashover, as defined in NFPA 286, shall not occur.
 - 3. The peak rate of heat release throughout the NFPA 286 test shall not exceed 800 kW.
 - 4. The total smoke released throughout the NFPA 286 test shall not exceed 1,000 m².

2.02 PLASTIC TOILET & SHOWER PARTITIONS

- A. Solid Plastic Partitions: Factory fabricated doors and fixed panels made of solid molded high density polyethylene (HDPE), with all edges eased/chamfered; tested in accordance with NFPA 286; wall/pilaster mounted.
 - 1. Color: As selected by Architect from manufacturer's full range of NFPA 286 compliant colors.
 - 2. Doors:
 - a. Thickness: 1/2 inch.
 - b. Door Width: Varies by location. Refer to Drawings for rough opening dimensions. Refer to Drawings for directions of door swings.
 - c. Height: 46 inch nominal.
 - d. Provide custom 1 inch chamfer at all exposed top and bottom corners of doors.

2.03 ACCESSORIES

- A. Material for Hardware and Accessories: Provide stainless steel or anodized aluminum as indicated, with satin finish. Where not indicated, Contractor may provide either material at its option. Zamac is not acceptable.
- B. Head Rails: Extruded aluminum, anti-grip profile.
 - 1. Size: Manufacturer's standard size.
- C. Steel Post Pilaster: Where pilaster is indicated between door and fixed panel; provide 4 inch by 4 inch square steel post with minimum 3/16 inch wall thickness, and with welded top closure plate. Fully weld post to 7 inch diameter by 1/4 inch base plate; floor mount with four 1/2 inch by 3 inch tamper-resistant anchors; concrete wedge anchors or epoxy adhesive.
- D. Wall and Pilaster Brackets: At fixed panel locations; mount to wall or to steel post pilaster with continuous bracket fabricated of stainless steel or natural anodized aluminum with minimum 0.125 inch wall thickness; continuous type.
- E. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.
 - 1. For attaching panels and pilasters to brackets: Through-bolts and nuts; tamper proof.
- F. Hinges:
 - 1. Pivot Hinges (Heavy-Duty): Provide a full-length "spine" hinge system sized for door height indicated. Hinge system shall include top and bottom stainless steel pivot hinges with in-line cam, coil spring, and gravity assist closing system, and with aluminum full height bracket on each side of door panel; through-bolted.
 - a. Hinge system shall be secured to wall with tamper-resistant anchors approved by manufacturer for CMU substrate.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify correct spacing of and between plumbing fixtures.
- C. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

- A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.

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- B. Install toilet partitions with minimum 12 inch toe space clearance from bottom of partition to top of finished floor surface. Do not exceed 12-1/2 inch clearance above finished floor.
- C. Maintain 3/4 inch space between door swign side and adjacent wall.
- D. Attach hinges and panel brackets securely to walls using anchor devices.
- E. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.

3.03 TOLERANCES

- A. Maximum Variation From True Position: 1/4 inch.
- B. Maximum Variation From Plumb: 1/8 inch.

3.04 ADJUSTING

- A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.
- B. Adjust hinges to position doors to return to closed position.
- C. Adjust adjacent components for consistency of line or plane.

END OF SECTION 102113.19

**SECTION 102213
WIRE MESH PARTITIONS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
- B. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- C. ASTM A510/A510M - Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel.
- D. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification.
- E. AWS D1.1/D1.1M - Structural Welding Code - Steel.

1.02 SUBMITTALS

- A. Product Data: Provide data for mesh materials, finishes, and dimensions of pre-fabricated components.
- B. Shop Drawings: Indicate plan and vertical dimensions, elevations, component details; head, jamb, and sill details; location of hardware. Provide component details, anchorage, and type and location of fasteners.
 - 1. Show field measurements on shop drawings.
- C. Selection Samples: Manufacturer's color charts indicating standard range of finishes.
- D. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Wire Mesh Partitions:
 - 1. Acorn Wire and Iron Works, Inc; Standard Duty 10-Gauge.
 - 2. The G-S Company; Sure Guard Standard Duty.
 - 3. Indiana Wire Products, Inc; 150C.
 - 4. Miller Wire Works, Inc; No 100M - Standard.
 - 5. Newark Wire Works, Inc; Type 120.
 - 6. Spaceguard Products; BeastWire Mesh Partitions with Standard Welded Wire Mesh- 2 inch square.
 - 7. Standard Wire & Steel Works; Wire Mesh Partitions with #10 gauge standard mesh.
 - 8. Substitutions: See Section 016000 - Product Requirements.

2.02 WIRE MESH PARTITIONS

- A. Wire Mesh Partitions: Factory-fabricated modular assemblies of panels, doors, anchors, hardware, and accessories as required to provide a complete system.
 - 1. Design Criteria:
 - a. Design partition system to provide for movement of components without damage, undue stress on fasteners or other detrimental effects, when subject to design loads.

- b. Design system to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

2.03 COMPONENTS

- A. Woven Wire Mesh: Standard duty.
 - 1. Material: ASTM A510/A510M uncoated crimped steel wire.
 - 2. Wire Size: 10 gauge, 0.135 inch.
 - 3. Mesh Opening Size: 1-1/2 inch diamond shape.
 - 4. Mesh Weave: Plain weave, double crimped.
- B. Framing and Support Members:
 - 1. Material: ASTM A36/A36M steel shapes and ASTM A500/A500M cold-formed steel tubing.
 - 2. Framing, Corner Posts, and Intermediate Support Members: Manufacturer's standard sizes for system specified and as indicated on drawings.
 - 3. Vertical Stiffeners: As required for partitions greater than 144 inches in height.
- C. Doors: Same material as partitions, fully framed; manufacturer's standard construction and hardware for swing operation.
 - 1. Locking: Mortise type cylinder locks, keyed on both sides. Coordinate with security/detention cylinder and keying per Division 11 Section "Security Hardware".
- D. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

2.04 FASTENERS

- A. Bolts, Nuts and Washers: Hot dip galvanized.
- B. Anchorage Devices: Provide power driven, powder actuated, and drilled expansion bolts.
- C. Exposed Mechanical Fastenings: Flush countersunk screws or bolts, unobtrusively located, consistent with design of structure.

2.05 ACCESSORIES

- A. Bracing: Formed sheet steel, thickness determined for conditions encountered, manufacturer's standard shapes, same finish as framing members.
- B. Plates, Gussets, Clips: Formed sheet steel, thickness determined for conditions encountered, manufacturer's standard shapes, same finish as framing members.
- C. Floor and Ceiling Pilaster Shoe: Manufacturer's standard.
- D. Floor Base: Manufacturer's standard.

2.06 FABRICATION

- A. Fit and assemble in largest practical sections for delivery to site, ready for installation.
- B. Make exposed joints flush or tight.
- C. Provide mortised and tenoned joints for framing members.
- D. Provide components required for anchorage to adjacent construction.

2.07 FINISHES

- A. Painted Finish: Manufacturer's standard powder coat finish.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated on shop drawings.
- B. Verify that substrate surfaces and required openings are ready to receive work.

3.02 PREPARATION

- A. Clean substrate surfaces.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install items plumb and level, accurately fitted, free from distortion or defects.
- C. Perform field welding in accordance with AWS D1.1/D1.1M.
- D. After installation, touch-up field welds scratched or damaged surfaces with shop applied finish.

3.04 TOLERANCES

- A. Maximum Variation From Plumb or Level: 1/4 inch.
- B. Maximum Misalignment From True Position: 1/4 inch.

3.05 ADJUSTING

- A. Adjust doors to achieve free movement.

3.06 CLEANING

- A. Remove temporary protection to prefinished surfaces.

END OF SECTION 102213

**SECTION 102600
WALL AND DOOR PROTECTION**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
- B. ASTM F476 - Standard Test Methods for Security of Swinging Door Assemblies.
- C. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.
- D. SCAQMD 1168 - Adhesive and Sealant Applications.

1.02 SUBMITTALS

- A. Product Data: Indicate physical dimensions, features, wall mounting brackets with mounted measurements, anchorage details, and rough-in measurements.
- B. Shop Drawings: Include plans, elevation, sections, and attachment details.
- C. Selection Samples: Provide manufacturer's color charts for each product and material requiring color selection.
- D. Verification Samples: Submit physical samples, manufacturer's standard size, for each selected color.
- E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wall and door protection items in original, undamaged protective packaging. Label items to designate installation locations.
- B. Protect work from moisture damage.
- C. Protect work from UV light damage.
- D. Do not deliver products to project site until areas for storage and installation are fully enclosed, and interior temperature and humidity are in compliance with manufacturer's recommendations for each type of item.
- E. Store products in either horizontal or vertical position, in compliance with manufacturer's instructions.

1.04 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 5-year manufacturer warranty for metal crash rails. Complete forms in Owner's name and register with manufacturer.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures or internal connection failures.
 - b. Deterioration of materials beyond that expected of normal use, as intended by manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Crash Rails:
 - 1. Construction Specialties, Inc.; SCR Series.
 - 2. Inpro.
 - 3. Nystrom, Inc.
 - 4. Pawling Corp.
 - 5. Substitutions: See Section 016000 - Product Requirements.

2.02 PERFORMANCE CRITERIA

- A. Impact Strength: Unless otherwise noted, provide protection products and assemblies that have been successfully tested for compliance with applicable provisions of ASTM D256 and/or ASTM F476.
- B. Adhesives and Sealants: Adhesives and sealants field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with CAL (CDPH SM) AND shall meet the chemical content requirements of SCAQMD 1168.

2.03 PRODUCT TYPES

- A. Metal Crash Rails: Factory- or shop-fabricated, with preformed end wall returns, and internal and external corners:
 - 1. Basis-of-Design: Construction Specialties; Model CRSS.
 - 2. Performance of Installed Assembly:
 - a. Support vertical live load of 100 lb/lineal ft with deflection not to exceed 1/50 of span between supports.
 - b. Resist lateral force of 250 lbs at any point without damage or permanent set.
 - 3. Material: Metal; minimum 16 gauge Stainless Steel, type 304.
 - 4. Mounting: Surface.
 - 5. Rail Type: Continuous metal bar.
 - a. Rail Profile: Rectangular, 1-1/2 inch by 5 1/2 inch, with eased edges; mounted directly to wall over wood retainer/blocking.
 - b. Rail Configuration: Continuous line, with terminations only installed at doors, electrical panels, and fire-extinguisher cabinets, and other wall mounted items or penetrations; including items prohibited from being blocked by authorities having jurisdiction. Maintain rail continuity around all other wall configurations, protrusions, piers, abutments, and similar items. Rail and bracket layout to maintain typical projection dimension from wall to inside of rail, unless otherwise indicated.
 - 1) Provide end caps at all terminations.
 - 6. Finishes.
 - a. Stainless steel, No.4 Satin directional finish.
- B. Adhesives and Primers: As recommended by manufacturer.

2.04 FABRICATION

- A. Fabricate components with tight joints, corners and seams.

2.05 SOURCE QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.

- B. Provide wall and door protection systems of each type from a single source and manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.
- B. Verify that field measurements are as indicated on drawings.
- C. Verify that substrate surfaces for adhered items are clean and smooth.
 - 1. Test painted or wall covering surfaces for adhesion in inconspicuous area, as recommended by manufacturer. Follow adhesive manufacturer's recommendations for remedial measures at locations and/or application conditions where adhesion test's results are unsatisfactory.
- D. Start of installation constitutes acceptance of project conditions.

3.02 INSTALLATION

- A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to supporting construction.
- B. Position top of corridor crash rail 36 inches from finished floor, unless otherwise indicated.
- C. Terminate rails 1 inch short of door openings and intersecting walls and provide end caps.

3.03 TOLERANCES

- A. Maximum Variation From Required Height: 1/4 inch.
- B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch.

3.04 CLEANING

- A. See Section 017419 - Construction Waste Management and Disposal, for additional requirements.
- B. Clean wall and door protection items of excess adhesive, dust, dirt, and other contaminants.

END OF SECTION 102600

**SECTION 102800
TOILET AND BATH ACCESSORIES**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design.
- B. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- D. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- E. ASTM C1036 - Standard Specification for Flat Glass.
- F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.
- G. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror.
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- I. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with the placement of internal wall reinforcement and reinforcement of toilet partitions to receive anchor attachments.

1.03 SUBMITTALS

- A. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.
- B. Setting Drawings: For cutouts required in other work; include templates, substrate preparation instructions, and directions for preparing cutouts and installing anchoring devices.
- C. Maintenance Data: For each type of accessory, to include in maintenance manual per Section 017800 - Closeout Submittals. Include list of replacement parts and service recommendations.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Commercial Toilet, Shower, and Bath Accessories:
 - 1. American Specialties, Inc.
 - 2. Bobrick Washroom Equipment.
 - 3. Bradley Corporation.
- B. Under-Lavatory Pipe Supply Covers:
 - 1. Plumberex Specialty Products, Inc.
 - 2. Truebro; IPS Corporation.
- C. Provide products of each category type by single manufacturer.

2.02 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
- B. Keys: Provide 6 master/universal keys, minimum, to Owner.
- C. Stainless Steel Sheet: ASTM A666/A666M, Type 304.
- D. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.
- E. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.
- F. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.
- G. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.
 - 1. Provide mechanical attachment of all accessories. Use of adhesive or double-side tape is not acceptable.

2.03 FINISHES

- A. Stainless Steel: Satin finish, unless otherwise noted.

2.04 TOILET ACCESSORIES SCHEDULE, GENERAL

- A. General: The following products make reference to the designations indicated on the Toilet Accessories Schedule, Toilet Assemblies, and toilet room plans on the drawings; herein designated as "TA-x".

2.05 COMMERCIAL TOILET AND BATH ACCESSORIES

- A. Grab Bars (TA-A, B, & C): Stainless steel, smooth surface.
 - 1. Standard Duty Grab Bars:
 - a. Push/Pull Point Load: 250 pound-force, minimum.
 - b. Dimensions: 1-1/4 inch outside diameter, minimum 0.05 inch wall thickness, concealed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
 - c. Finish: Satin.
 - d. Length and Configuration: As indicated on drawings.
 - e. Products:
 - 1) American Specialties, Inc.; 3700 Series.
 - 2) Bobrick Washroom Equipment, Inc.; B-5806 Series.
 - 3) Bradley Corporation; 832 Series.
- B. Toilet Paper Dispenser (TA-D): Roll-in-reserve type, designed to allow automatic activation of reserve roll when needed, or manual activation by pressing release bar, surface-mounted, stainless steel unit with pivot hinge, tumbler lock.
 - 1. Products:
 - a. American Specialties, Inc.; Model 20030.
 - b. Bobrick Washroom Equipment, Inc.; Model B-4288.
 - c. Bradley Corporation; Model 5402.
- C. Sanitary Napkin Disposal Unit (TA-E): Stainless steel, surface-mounted, self-closing door, with full-length stainless steel piano-type hinge, removable receptacle.
 - 1. Products:
 - a. American Specialties, Inc; Model 20852.

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- b. Bobrick Washroom Equipment, Inc.; Model B-270 Contura.
 - c. Bradley Corporation; Model 4781-11.
- D. Soap Dispenser (TA-F): Liquid soap dispenser, wall-mounted, surface, with stainless steel cover and vertical stainless steel tank and working parts; push type soap valve, check valve, and window gauge refill indicator, tumbler lock.
 - 1. Minimum Capacity: 40 ounces.
 - 2. Products:
 - a. American Specialties, Inc.; Model 0347.
 - b. Bobrick Washroom Equipment, Inc.; Model B-2111.
 - c. Bradley Corporation; Model 6562.
- E. Mirrors (TA-G): Stainless steel framed, 1/4 inch thick annealed float glass; ASTM C1036.
 - 1. Annealed Float Glass: Silvering, protective and physical characteristics in compliance with ASTM C1503.
 - 2. Size: As indicated on Drawings.
 - 3. Frame: 0.05 inch angle shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.
 - 4. Products:
 - a. American Specialties, Inc; 0600 A Series.
 - b. Bobrick Washroom Equipment, Inc.; Model B-290.
 - c. Bradley Corporation; Model 780.
- F. Corner Grab Bar Assembly (TA-H): Stainless steel, smooth surface.
 - 1. Stainless-Steel Nominal Thickness: 0.05 inch.
 - 2. Finish: Satin.
 - 3. Mounting: Concealed with manufacturer's standard flanges and anchors.
 - 4. Outside Diameter: 1-1/4 inches unless otherwise indicated.
 - 5. Configuration: Single "L" shaped shower grab bar.
 - a. Length (Control Wall): 32 to 34 inches from wall to centerline of return.
 - b. Length (Back Wall): Nominal 18 inches from wall to centerline of return. Limit leg length so as not to interfere with folding shower seat.
 - 6. Products:
 - a. American Specialties, Inc.; Model 3774.
 - b. Bobrick Washroom Equipment, Inc.; Model B-6861 (1-1/2 inches OD).
- G. Folding Shower Seat (TA-J): Wall-mounted surface; welded tubular seat frame, structural support members, hinges, and mechanical fasteners of Type 304 stainless steel, L-shaped seat.
 - 1. Seat: Phenolic or polymeric composite one-piece seat or seat slats, of manufacturer's standard color.
 - 2. Size: ADA Standards compliant.
 - 3. Products (L-Shaped - 33" to 34.5" wide, reversible):
 - a. American Specialties, Inc.; Model 8206.
 - b. Bobrick Washroom Equipment, Inc.; Model B-5181.
 - c. Bradley Corporation; Model 9569.
- H. Robe Hook (TA-T): Heavy-duty stainless steel, double-prong, rectangular-shaped bracket and backplate for concealed attachment, satin finish. Provide one centered on interior face of door

of all single-user toilet rooms, unless otherwise indicated on Drawings; verify final mounting locations with Architect in field.

1. Products (Double-Prong):
 - a. American Specialties, Inc.; Model 7345.
 - b. Bobrick Washroom Equipment, Inc.; Model B-7672.
 - c. Bradley Corporation; Model 9124.

2.06 UNDER-LAVATORY PIPE AND SUPPLY COVERS

- A. Under-Lavatory Pipe and Supply Covers:
 1. Insulate exposed drainage piping, including hot, cold, and tempered water supplies under lavatories or sinks to comply with ADA Standards.
 2. Exterior Surfaces: Smooth non-absorbent, non-abrasive surfaces.
 3. Construction: 1/8 inch flexible PVC.
 - a. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 - b. Microbial and Fungal Resistance: Comply with ASTM G21.
 4. Color: White.
 5. Fasteners: Reusable, snap-locking fasteners with no sharp or abrasive external surfaces.
 6. Products:
 - a. Plumberex Specialty Products, Inc; Plumberex Trap Gear.
 - b. Truebro; IPS Corporation; Lav Guard 2.

2.07 UTILITY ROOM ACCESSORIES

- A. Combination Utility Shelf/Mop and Broom Holder (TA-X): 0.05 inch thick stainless steel, Type 304, with 1/2 inch returned edges, 0.06 inch steel wall brackets.
 1. Drying rod: Stainless steel, 1/4 inch diameter.
 2. Hooks: Three, 0.06 inch stainless steel rag hooks at shelf front.
 3. Mop/broom holders: Four spring-loaded rubber cam holders at shelf front.
 4. Length: 36 inches.
 5. Products:
 - a. American Specialties, Inc; Model 1315-4.
 - b. Bobrick Washroom Equipment, Inc.; Model B-224 x 36.
 - c. Bradley Corporation; Model 9984.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.

3.02 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
- B. Install plumb and level, securely and rigidly anchored to substrate.

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- C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated on Drawings.

3.03 PROTECTION

- A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION 102800

**SECTION 104400
FIRE PROTECTION SPECIALTIES**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. FM (AG) - FM Approval Guide.
- B. NFPA 10 - Standard for Portable Fire Extinguishers.
- C. UL (DIR) - Online Certifications Directory.

1.02 SUBMITTALS

- A. Product Data: Provide extinguisher operational features and extinguisher ratings and classifications.
- B. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.03 FIELD CONDITIONS

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fire Extinguishers and Accessories:
 - 1. Activar Construction Products Group, Inc. - JL Industries.
 - 2. Amerex Corporation.
 - 3. Ansul, a Tyco Business.
 - 4. Babcock-Davis.
 - 5. Badger Fire Protection.
 - 6. Buckeye Fire Equipment Company.
 - 7. Fire-End & Croker Corporation.
 - 8. Kidde, a unit of United Technologies Corp.
 - 9. Modern Metal Products; Div of Technico.
 - 10. Larsen's Manufacturing Co.
 - 11. MOON American.
 - 12. Nystrom, Inc.
 - 13. Oval Brand Fire Products.
 - 14. Potter-Roemer.
 - 15. Pyro-Chem, a Tyco Business.
 - 16. Strike First Corporation of America.

2.02 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
 - 1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.

- B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
 - 1. Class: 4-A: 60-B:C.
 - 2. Size: 10 pound.
 - 3. Finish: Baked polyester powder coat, manufacturer's standard color.
 - 4. Temperature Range: Minus 40 degrees F to 120 degrees F.
- C. Wet Chemical Type Fire Extinguishers: Stainless steel tank, with pressure gauge. Provide in commercial kitchen area.
 - 1. Class: K type.
 - 2. Size: 1.6 gallons.
 - 3. Finish: Manufacturer's standard polished stainless steel.
 - 4. Temperature Range: Minus 20 degrees F to 120 degrees F.

2.03 ACCESSORIES

- A. Extinguisher Brackets: Formed steel, chrome-plated or baked-enamel finish.
- B. Lettering: "FIRE EXTINGUISHER" decal, or vinyl self-adhering, pre-spaced lettering in accordance with authorities having jurisdiction (AHJ).
 - 1. Apply to wall surface at bracket mounted extinguishers.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install mounting brackets at 44 inches above finish floor.
- C. Secure rigidly in place.
- D. Place extinguishers on wall brackets as applicable.
- E. Install extinguisher signage.

3.03 PROTECTION AND CLEANING

- A. Protect fire extinguishers and accessories from damage until Substantial Completion.
- B. Provide touchup to damaged finishes; replace items that cannot be satisfactorily repaired or refinished.

END OF SECTION 104400

SECTION 111900 - DETENTION EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUMMARY

- A. Detention Equipment Contractor (DEC):

- 1. Provide the Detention Equipment indicated on the Drawings, in schedules, and as specified in this section.
- 2. Types of Detention Equipment:
 - a. Detention Mirror, Single & Double
 - b. Detention Swing Stool, wall-mounted
 - c. Recessed Toilet Paper Roll Holder
 - d. Detention Grab Bars, Anti-Ligature
 - e. Detention Shower Grab Bars, Anti-Ligature
 - f. Wall Embed Plates for detention grab bars
 - g. Detention Folding Shower Seat
 - h. Safety Shower/Clothes Hook
- 3. Refer Division 22 Section "Security Plumbing Fixtures" for detention equipment provided in and/or as part of the construction of cabinet showers, including, but not limited to, wall-mounted grab bars and stainless-steel shower seats.
- 4. Furnish to the General Contractor, for installation, all embedded anchors for Detention Equipment.
- 5. Coordinate installation of the embedded items and the actual detention equipment with the appropriate Contractors.
- 6. Coordinate with the Security Control System Contractor (SCSC), as described in Section 285000.

- B. General Contractor:

- 1. Install embedded anchors for Detention Equipment in accordance with manufacturers and detention equipment subcontractor's shop drawings.
- 2. Coordinate installation of embedded items with the DEC.

1.3 QUALITY ASSURANCE

- A. The Detention Equipment Contractor (DEC) shall provide all detention equipment, shop drawing submittals, testing reports, and samples as described in Specification Sections 111900, 111910, 111950, and 111960. The DEC shall coordinate the work of all these specification sections with his various equipment manufacturers, fabricators, installers, and, also, with work by others. Questions on the Detention Work shall be directed to the DEC before being directed to the General Contractor, Architect, or Owner.

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B. Available Detention Equipment Contractors (DEC):

1. Cornerstone Detention Decatur, AL 35601	2. Montgomery Technology Systems Greenville, AL 36037 & San Antonio, TX 78219
3. Pauly Jail Building Company Noblesville, IN 46062	4. CML Security, LLC Broomfield, CO 80023
5. Noah Detention Construction, LLC Niceville, Florida 32578	

1.4 DETENTION EQUIPMENT CONTRACTOR'S (DEC) QUALIFICATIONS

- A. It is critical that the Detention Equipment meets the requirements of the Contract Documents and that the equipment and/or systems be properly installed and functioning correctly by the Time of Completion specified.
- B. A specialty DEC is required for this project. Refer to Sections 111900, 111910, 111950, and 111960 for scope of work.
- C. It is not, however, the intent of the Owner or Architect to unfairly restrict competition. Other equally competent DEC's who meet the 'qualification criteria' specified herein shall be added to the list of 'Available Detention Equipment Contractors (DEC)' by addendum.
- D. All competent non-listed DEC's may request to be listed by submitting the data requested in the Qualification Criteria, a minimum of fifteen (15) days prior to bid receipt date.
- E. All other competent DEC's will be listed in an addendum. Verbal approval will not satisfy this requirement. Grounds for disqualification shall exist if, in the opinion of the Architect, the information submitted is inaccurate or does not comply with the requirements of this specification. There will be no exceptions.
- F. QUALIFICATION CRITERIA FOR THE DEC: It is critical that the Detention Equipment meets the requirements of the Contract Documents and that the equipment and systems be properly installed and functioning correctly by the Time for Completion specified for the project. Therefore, the DEC must meet the following qualification criteria:
1. Perform at least 50 percent of the Work (on-site installation) with its employees. Submit payroll record of executing project installation labor with a minimum of 50 percent of labor performed by direct employees of the DEC Company.
 2. Provide a narrative of the history of the company from inception, including history of ownership, partnership, incorporation and/or other organizational information. Include information on the growth of the firm over time to include the number of employees, relocation(s) of the firm, major production equipment purchases and replacements. Use only the current corporate/business entity, intending on bidding and performing the work.
 3. Provide a statement that the firm has been in business under its current name for a minimum of ten (10) continuous years.
 4. Provide a list of all employees in supervisory positions stating their area of responsibility and their years of experience in that position.
 - a. Number of years as a full-time employee of the DEC
 - b. Number of years of jail experience
 - c. Completed training program for iron workers (if involved in equipment installation)

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5. Submit a complete list of all projects completed under the DEC's current name. Specifically highlighting projects completed in NC, SC and VA, including:
 - a. Project Name, Owner, Contact Name, Address, and Phone Number
 - b. Architect/Engineer of Record Name, Address, and Phone Number
 - c. General Contractor or Construction Manager Name, Address, and Phone Number
 - d. Total Amount of the DEC's Contract and Completion Date
6. Submit a listing of all jobs in which the DEC is presently and has been involved in litigation and the status thereof.
7. Provide a list of all the jobs that your firm has been involved in liquidated damages or delay damages were filed against your firm.
8. Submit a letter of intent to test each detention door as described in Section 111910.
9. Submit for approval the name of the detention equipment manufacturers you intend to purchase from. Submit a current letter from the detention hardware manufacturer stating that the DEC is factory trained, fully authorized distributor and installer of their complete line of products.
10. Provide signed statement that DEC has not been found guilty of charges relating to conflicts of interest or to any criminal activity relating to construction methods, bidding, bid rigging, or bribery in the past five years.
11. Provide signed statement that DEC has not been found guilty of charges relating to employment of illegal aliens on construction projects in the last five (5) years.
12. Provide a letter from 'A' rated surety company that your company will be able to provide a 100 percent Performance/Payment bond for this project if awarded the project, but not less than \$3 million dollars.
13. Provide a financial statement for the most recent fiscal year.

1.5 ACTION SUBMITTALS

- A. A shop drawing submittal review meeting shall be held and coordinated by the General Contractor within two weeks after submittal. All participants should have at least two (2) weeks' worth of review of this first Shop Drawing submittal and be prepared to comment on its appropriateness for their assigned job efforts. The meeting shall last no longer than three (3) eight-hour days. A qualified representative from each of the following entities shall be present at the meeting:
 1. Owner
 2. Architect
 3. General Contractor
 4. Detention Equipment Contractor
 5. Security Control System Contractor
 6. Security Hollow Metal Manufacturer
 7. Security Glazing Manufacturer
 8. Sliding Door Manufacturer
 9. Security Hardware Manufacturer
 10. Architectural Hardware Subcontractor
 11. Electrical Contractor
- B. Failure to follow submittal criteria will constitute submittals being non-compliant and will be reviewed as "Rejected/Resubmit". The DEC must submit the indicated and necessary shop

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drawing criteria for each individual specification section as an entire section and for each subsequent re-submittal.

- C. Required submittal packages shall be submitted as a complete package for each Division 11 specification section. Failure to do so will result in the submittal being "Rejected" and returned.
- D. Manufacturer's Data
 - 1. Submit one (1) reproducible (digital format) copy of manufacturer's product specifications and installation instructions for each type of Detention Equipment.
 - 2. Provide product data for shop primer and factory-applied finish(es).
- E. Product Schedule: For detention equipment. Indicate types, quantities, sizes, and installation locations by room of each accessory required. Use same designations indicated on Drawings.
- F. Shop Drawings
 - 1. Submit one (1) reproducible (digital format) copy of all proposed and/or specified detention equipment.
 - 2. Include plan and elevation layouts, construction details, embed plate locations and details, material descriptions, fastener and anchorage details, inserts, dimensions of individual components, and finishes.
- G. Samples
 - 1. Submit (upon the Owner's or Architect's request) one (1) each sample of any or all proposed and/or specified detention equipment items, to the Owner for his review and final approval. Coordinate with the Owner's representative as to whom and where these samples are to be delivered.
- H. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for factory-applied color finishes for detention equipment and furniture.
 - a. Color selections will be made according to Section 013300.

1.6 PRODUCT HANDLING

- A. Protect units and finishes from damage during shipping, storage, handling, installation, and construction of other work in the same area.
- B. Wrap, crate, and label each item for protection from damage. Deliver pertinent items to be built-in to the General Contractor or trades in accordance with the construction progress schedule to prevent any delay.
- C. Keys shall be sent directly to the person and address as directed by the Owner, via direct mail with restricted delivery and return receipt requested.

1.7 GUARANTEE

- A. Upon final completion, the Manufacturer/Installer shall provide a written warranty covering detention equipment against defective materials and workmanship and guaranteeing satisfactory operation and performance for a period of one (1) year after Substantial Completion. The Manufacturer/Installer shall make necessary adjustments and replace any defective or broken parts caused by defective mechanical parts.

PART 2 - PRODUCTS

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2.1 DETENTION EQUIPMENT

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
1. Southern Folger Detention Equipment Co.; San Antonio, TX
 2. Modern Detention Equipment; Cincinnati, OH
 3. Willo Products Co.; Decatur, AL
 4. JAILS Correctional Products; Minster, OH
 5. Viking Products; Orange, CA
 6. Bob Barker Company, Inc.; Fuquay-Varina, NC
 7. Majestic Solutions, Inc.; Madison, AL
 8. Trussbilt; Vadnais Heights, MN
 9. Northwest Specialty Hardware, Inc. Clackamas, OR
- B. Individual Detention Equipment Items:
1. **Detention Mirror, Single & Double:** with Embedded Back Plate
 - a. Acceptable Manufacturer:
 - 1) SS No. 432/Southern Folger Detention Equip Co.
 - b. Construction:
 - 1) Mirrors:
 - a) Mirror frame shall be 11-1/4 inches by 17-1/4 inches, fabricated from 16 gauge cold finished steel, with 5/16 inch inner and outer flanges and having a tensile strength of not less than 53,000 pounds per square inch. Frame to have natural finish, chromium plated.
 - b) Mirror opening shall be 10 inches by 14 inches, made of 0.031-inch sheet steel, polished to a high degree of reflectivity, and chromium plated.
 - c) Include eight (8) chromium plated, security type, flat head machine screws, 1/4-inch diameter of proper length for use in backer plate.
 - 2) Embed Back Plates:
 - a) Provide steel embed plates and 11-gauge anchor tabs as detailed and/or required by the mirror manufacturer (refer to details on Drawings).
 2. **Detention Swing Stool, Wall-Mounted:**
 - a. Acceptable Manufacturer
 - 1) Wall Mounted Stool / Willo
 - 2) No. BB518SS / Bob Barker Co. (modified)
 - 3) J-1-2528_25 / Jails Correctional Products (modified)
 - 4) Wall-mounted Stool (swing) / Trussbilt (modified)
 - b. Construction:
 - 1) Stool seat shall be minimum 12 inches in diameter, with minimum 1-1/2 inch flange, fabricated of 16 gauge stainless steel, type 304 with No. 3 finish. Seat shall be attached to a minimum 1/4 inch thick steel seat reinforcement plate.
 - 2) Seat support shall be constructed of a 3/8 inch steel plate arm, welded to a 1 inch diameter steel swivel pin and to the seat reinforcement plate.
 - 3) Provide minimum 3/8 inch thick steel embed plate; seat swing arm shall be field welded to plate.
 - 4) Provide a non-removable hinge pin for locking the seat in place.

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- 5) The stool shall lock in the 90-degree position as well as in a position that allows for accessibility requirements.
3. **Recessed Toilet Paper Roll Holder:**
- a. Acceptable Manufacturer:
 - 1) SA11/ Bradley Corporation (modified)
 - 2) RTH-1/Willoughby Industries, Inc. (modified)
 - 3) 1840/Acorn Engineering Co. (modified)
 - b. Construction (refer to details on Drawings):
 - 1) Recessed holder shall be 5 inches inside diameter and 4-1/2 inches deep made of 14 gauge Type 304 Stainless Steel.
 - 2) The face trim rim shall be beveled so as to fit flush with the wall surface and have an architectural satin finish.
 - 3) Four (4) anchor angles, 1 inch by 2-1/2 inches by 1/4 inch (1 inch wide) shall be welded to the exterior walls of the recessed enclosure with the 2-1/2 inch angle leg extended.
4. **Detention Grab Bars, Anti-Ligature:**
- a. Construction (refer to details on Drawings)
5. **Detention Shower Grab Bars, Anti-Ligature:**
- a. Acceptable Manufacturer:
 - 1) 1109 Series/Acorn Engineering Co.
 - 2) US130-G / A & J Washroom Accessories
 - 3) Model SA70-059 / Bradley Corporation
 - b. Construction (Refer to details on Drawings):
 - 1) Tubing: Provide 18 gauge, type 304 stainless steel, satin finish.
 - 2) Flanges: Minimum 11 gauge stainless steel, welded to bar.
 - 3) Closure Plate: 11 gauge stainless steel welded to underside of bar.
 - c. Provide embed plate, drilled and tapped for security fasteners, with anchor straps.
 - d. Locate Grab Bars to comply with accessibility codes.
6. **Wall Embed Plates for detention grab bars:**
- a. Acceptable Manufacturer:
 - 1) (Custom fabricated)
 - b. Construction (Refer to details on Drawings):
 - 1) Embed Wall Plates shall be 1/2 inch thick Stainless Steel plates dimensioned as indicated on the drawings with embedment anchor tabs.
 - 2) Grab Bars shall be bolted to embed plates as noted on the Drawings.
7. **Detention Folding Shower Seat:**
- a. Acceptable Manufacturer:
 - 1) No. SS2 / Viking Products.
 - 2) Model 1103-31 & 32 / Acorn Engineering Co.
 - b. Performance standards;
 - 1) Support up to 700-pound static load.
 - c. Construction:
 - 1) Provide 10 gauge, satin finish, type 304 stainless steel L-shaped seat with minimum 2" x 2" x 11 gauge channels or tubes welded to underside of seat.
 - 2) Provide minimum 1" diameter x .120 thick stainless steel tube supports and minimum 4" diameter x 3/16" stainless steel wall flanges.

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- 3) Provide 10 gauge stainless steel seat catch to hold seat in upright position against the wall.
 - 4) Provide embed plate, drilled and tapped for security fasteners, with anchor straps.
 - 8. **Safety Shower/Clothes Hook:** (Individual Hook Assembly mounted onto a steel embed plate)
 - a. Acceptable Manufacturer:
 - 1) No. 1829 / Acorn Engineering Co. (similar).
 - 2) No. B-983 / Bobrick Washroom Equipment Inc. (similar).
 - 3) Model SA36 / Bradley (similar).
 - 4) No. 407 / Southern Folger Detention Equip Co.
 - b. Construction (Refer to details on Drawings):
 - 1) Provide 14 gauge, satin finish, type 304 stainless steel plate with stainless steel, ball-type collapsible hooks.
 - 2) Provide embed plate, drilled and tapped for security fasteners, with anchor straps.
- 2.2 DETENTION EQUIPMENT ACCESSORIES
- A. Provide accessories, anchorage inserts and security fasteners for a complete tamperproof installation.
 - 1. Exposed Security Fasteners:
 - a. Provide Torx-head (star with center reject pin) security fasteners for anchoring work in exposed security areas.
 - b. Finish shall match that specified of the item anchored.
 - B. Provide tools for fastening devices.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the areas and conditions under which Detention Equipment is to be installed. Notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Proceed with installation only after unsatisfactory conditions have corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's printed installation instructions.
- B. Touch-up painting of factory finish or factory primed items is the installer's responsibility.
- C. Do not paint stainless steel embed plates.
- D. Identify and coordinate the 'Filling of all Voids', by the General Contractor, between all materials of Detention Equipment, embeds and/or other physical construction items. Refer to specification Section 079200 – Joint Sealants and its article on "SECURITY SEALANTS" for types of sealants to be utilized.
- E. All expenses incurred by the Architect in troubleshooting Detention Equipment Work, caused by inadequate workmanship or other form of non-performance on the part of the subcontractor, shall be borne by that subcontractor.

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- F. Coordinate installed equipment supplied to other contractors.

3.3 PROTECTION

- A. Protect equipment and finishes until Substantial Completion.
- B. Replace damaged equipment as directed by the Architect.

3.4 CLEANING

- A. Clean grout, mortar, and other bonding material off detention equipment immediately after installation.
- B. Touch-up Painting: Cleaning and touch-up painting of field welds, bolted connections and abraded areas of shop paint is specified in Division 9 Section "Painting".
- C. Field finish painting of all equipment (not supplied with factory finish) in this section shall be done in accordance with Division 9 Section "Painting". All equipment shall be painted to match the color of its adjacent wall finish color, unless noted otherwise.
- D. Clean equipment thoroughly prior to Substantial Completion.

END OF SECTION 111900

SECTION 111910- CUSTOM / SECURITY HOLLOW METAL WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Swinging detention doors.
2. Sliding detention doors.
3. Detention frames.

B. Detention Equipment Contractor (DEC):

1. Provide the Custom/Security hollow metal doors, door frames, window frames, and any other security hollow metal (SHM) (also referred to as Detention Hollow Metal (DHM)) components indicated on the contract document drawings, schedules, and specifications.
2. Provide all necessary embed plates and/or anchors.
 - a. Provide galvanized steel embed plates at concrete columns and other concrete construction for anchoring of SHM frames. Coordinate installation of embed plates and other anchorages. Furnish setting drawings, templates, diagrams, and instructions for items to be embedded. Deliver such items to Project site in time for installation.
3. Coordinate requirements for manual and electric hardware, monitoring and control devices, and SHM manufacturer-provided raceway/cabling junction boxes.
4. Coordinate all electrical requirements, by the Electrical Contractor, with the Security Control Systems Contractor (SCSC) and electrical contractor.
5. Schedule installation of this work to coincide with erection of the masonry work on the project so that these contractors can grout fill the custom/security hollow metal frames as their work is erected. The DEC is responsible for providing grout and grout holes for any frames that cannot be delivered and erected by the erection contractors.
 - a. Construction Schedule: Provide a separate line for Custom/Security Hollow Metal doors and frames, which shall include adequate time for shop drawing preparation, submittal review, fabrication, and delivery of frames to the project site in time to meet above requirement and requirements of paragraph 3.2.B.2 in "Installation" article ahead. Coordinate with General Contractor.
6. Provide on-site supervision of the delivery and installation of the custom/security hollow metal doors, frames, and windows.

C. General Contractor:

1. Take delivery of the custom/security hollow metal doors, door frames, window frames, embedded plates/anchors, and store per manufacturer's recommendations.
2. Install custom/security hollow metal doors, door frames and interior/exterior window frames, as indicated.
3. Install all embedded plates and/or anchors, provided by the DEC.

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- D. Electrical Contractor:
 - 1. Coordinate electrical requirements with General Contractor and DEC.
 - 2. Coordinate this work with the control needs of the Security Control Systems Contractor (SCSC).
- E. Provide Custom/Security hollow metal work manufactured by a single firm specializing in the production of this type of work.
- F. When a fire resistance classification is indicated or scheduled for steel doors and frames, provide fire-rated doors investigated and tested as a fire door assembly, complete with type of hardware to be used. Identify each fire door with recognized testing laboratory labels, indicating applicable fire rating of steel doors.
- G. Due to security concerns, no physical U.L. Fire Resistance Labels are to be attached to the door/frame assemblies. Instead, provide die-stamped identification numbers on fire-rated doors and frames and a letter of certification recording these numbers to the Owner/user for his record and files.
- H. Fire-Rated Assemblies: Provide door and frame assemblies and window frame assemblies complying with the North Carolina Building Code and NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Test Pressure: Test at positive pressure according to NFPA 252 or UL 10C. After 5 minutes into the NFPA 252 test, the neutral pressure level in furnace shall be established at 40 inches or less above the sill (per 2018 NC Building Code Section 716.5.1).
 - 2. Smoke and Draft Control Assemblies: Fire door assemblies located in smoke barrier walls shall also meet the requirements for a smoke and draft control door assembly tested in accordance with UL 1784. Installation of smoke doors shall be in accordance with NFPA 105.
- I. When a fire resistance classification is indicated or scheduled for steel doors and/or frames containing components that have not been tested as an assembly, the manufacturer shall construct the door and frame components of the assembly in accord with the resistance rating, and certify in writing to the Owner, Enforcing Authority, Contractor, and the Architect that the door and frame components have been constructed in accord with the testing laboratory requirements in lieu of label.
- J. Door and Panel Construction
 - 1. Field Examination:
 - a. The Custom/Security hollow metal contractor shall include in his bid the cost to provide one (1) replacement security hollow metal door that is to be selected for field testing.
 - b. When directed by the Architect, the Contractor shall destroy a randomly-selected security hollow metal door or panel by sawing it in half.
 - c. When examination discloses door construction at variance with the details specified, the door manufacturer shall replace all doors shipped to the project, as of the date of inspection, with doors constructed in conformance with project specifications.
 - d. Under conditions of nonconformity, the door manufacturer shall pay for the destroyed door and related labor.

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- e. When examination proves that the door was constructed in conformance with specifications, the Detention Equipment Contractor (DEC) shall immediately proceed to provide the replacements for the destroyed door.
- 2. All detention doors and panels for this Contract shall be constructed as specified and to meet the following ASTM Testing.
 - a. The following tests (ASTM F 1450 – 12a, Grade 2) shall be conducted by an independent testing laboratory, upon doors with documentation attesting to compliance with the detention door construction required and indicated in this section.
 - b. Doors for these tests shall utilize minimum 14 gauge face sheets, 12 gauge frames, 3 feet by 7 feet (nominal size), not exceeding 225 lbs. in weight, and shall be fabricated as Door Type “DN” without a food pass (refer to Detention Door Types on Drawings).
 - 1) Test A – Door Static Load Test:
 - a) Door shall be end supported and loaded at quarter points by a total load of 11,000 pounds for a period of one (1) minute. Door shall deflect not more than 0.580 inch (14.73 mm) and shall rebound to within 0.100 inch (2.55 mm) of flatness after the loading is removed.
 - 2) Test B – Door Rack Test:
 - a) Door shall be secured at one short dimension and support at one other short dimension; unsupported corner shall be loaded for 30 seconds with a load of 5,500 pounds. Results should be as follows: Unsupported corner's measured deflection shall not exceed 3.55 inches (90.52 mm). Rebound to within 1.40 inches (35.7 mm) of flatness with no visual signs of weld failure.
 - 3) Test C - Door Assembly Impact Test:
 - a) 3'-0" x 7'-0" door, frame, and hardware assembly shall be constructed and rigidly mounted in the vertical position such that the door and locking hardware are operable. The door shall swing on 1-1/2 pair of full mortised butt hinges, and shall be locked using a Southern Steel No. 1070, 1080 or 10120 series lock or equal, with bolt size not to exceed 2-inch-high x 3/4 inch wide, and latch throw not to exceed 7/8 inch.
 - b) A door ram pendulum system, capable of delivering consistent impacts of up to 200 feet lb., shall be constructed such that impacts may be delivered to any area of the assembly. The weight of the ram shall be 80 lb. $\pm$ 0.25 lb. The pendulum ram system shall be positioned opposite the door side of the assembly such that the door swings away from the ram. While hanging at rest, the ram shall be positioned such that the striking nose just touches the target area of the door. The striking nose shall be made from C1010-1020 low carbon steel, the striking surface area of which shall not exceed 4.0 square inches $\pm$ 0.04 square inches.
 - c) With the door closed and locked and the above testing arrangement secured, the following series of impact tests shall be performed from the push side of the assembly:

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Position and Order of Impacts	Number of Impacts	Impact Energy (ft. lbs.)
On door at center line of bolt, 6" from door edge	200	200
On door within 6" of bottom hinge	75	200
On door within 6" of center hinge	75	200
On door within 6" of top hinge	75	200
On the glass within 1.6" of the lower lock edge corner	100	200

d) The door shall remain closed and locked throughout the testing procedure, and the assembly shall not be damaged such that forcible egress can be obtained. After testing is completed, the door shall be capable of being unlocked and operated such that normal egress can be obtained.

4) Test D - Door Edge Crush Test:

a) Door shall be placed in test fixture, hinge side up. Apply pressure perpendicular to door edge until required loads are reached. Remove the door from the framework and place the door back into the test fixture, with the lock side up, and then repeat the test procedure. Required results: Both the hinge edge and lock edge shall support a load of at least 8,000 lbf with a deflection of less than 0.25 inch (6mm).

3. References:

- a. American Society of Testing and Materials (ASTM Standards F1450 and F1592)
- b. National Association of Architectural Metal Manufacturers (NAAMM)
- c. Hollow Metal Manufacturers Association (HMMA Standard 863)
- d. Underwriters Laboratories (UL)

1.3 ACTION SUBMITTALS

- A. Required submittal for Custom/Security Hollow Metal Work shall be submitted as a complete package. Failure to do so will result in the submittal being "Rejected" and returned.
- B. Manufacturer's Data
 1. Submit one (1) reproducible (digital format) copy of manufacturer's product specifications and installation instructions.
- C. Shop Drawings:
 1. Submit one (1) reproducible (digital format) copy of all proposed and/or specified custom security/detention hollow metal work, and elevation layouts.
 2. Include dimensional construction details of each detention frame type, elevations of door and frame design types, conditions at openings, fastener, anchorage, and reinforcement details. Provide details of lock pockets and factory fabricated accessories, including, but not limited to, food passes and lockable paper passes, location & installation requirements of finish hardware & reinforcements, and details of joints and connections. Provide frame details showing fixed steel detention panels. Provide details of doors, including vertical and horizontal edge details, and metal thicknesses.

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3. Drawings shall use the same plan and elevation numbers as indicated on the contract document drawings.

D. Certificates:

1. Manufacturer shall submit a certificate, individually dated and signed by hollow metal manufacturer, certifying that all materials meet specification requirements.
2. Welder certificates signed by Contractor certifying that welders comply with requirements (Section 4 of ANSI/AWS D1.3) specified under "Quality Assurance" article.

E. Owner's Tools

1. Furnish five (5) security fastener tools for each different type of security fastener, being utilized, at the time of Substantial Completion.

1.4 JOB CONDITIONS

- A. Hardware Coordination Conference: Refer to Finish Hardware and Security Hardware Specification Sections.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, and handle hollow metal work per manufacturer's requirements.

1.6 GUARANTEE

- A. Upon Final Completion, the Manufacturer/Installer shall provide a written warranty covering the custom / security hollow metal work against defective materials and workmanship and guaranteeing satisfactory operation and performance for a period of one (1) year after Final Completion. The Manufacturer/Installer shall make necessary adjustments and replace any defective or broken parts caused by defective mechanical parts.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS OF CUSTOM/SECURITY HOLLOW METAL:

- A. Manufacturers should submit evidence of successful detention facility experience within the last five years, and a list of projects of scope comparable to or larger than this project completed within the last five years, with Owner, Architect, and General Contractor contact names and telephone numbers.
1. Claborn Manufacturing Co.; Hartselle, AL
 2. Trussbilt (Trussbilt/American); Vadnais Heights, MN
 3. American Steel Products (Trussbilt/American); Swainsboro, GA
 4. Titan Steel Door, LLC; Gainesville, GA

2.2 MATERIALS

A. FERROUS METALS

1. Metal Surfaces, General: For hollow metal work exposed to view upon completion of the Work, provide materials selected for their surface flatness, smoothness, and freedom from surface blemishes. Do not use materials whose exposed surfaces exhibit pitting,

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- seam marks, roller marks, rolled trade names, roughness, and, for steel sheet, variations in flatness exceeding those permitted by reference standards for stretcher-leveled sheet.
2. Steel Plates, Shapes, and Bars: ASTM A 36.
 3. Uncoated Structural Steel Sheet:
 - a. Provide sheet steel types (manufacturing method), quality, and grade, as follows:
 - 1) Cold-Rolled Structural Steel Sheet: ASTM A1008/ A1008M, or as noted or required for loading.
 - 2) Hot-Rolled Structural Steel Sheet: ASTM A1011/ A1011M, unless otherwise noted or required for design loading rolled.
 4. Uncoated Steel Sheet: Commercial quality, cold-rolled steel sheet, ASTM A 366.
 5. Hot-Rolled Steel Sheet: ASTM A 1011.
 6. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, CS (Commercial Steel), Type B; with G60 (Z180) zinc (galvanized) or A60 (ZF180) zinc-iron-alloy (galvannealed) coating designation.
 7. Gray Iron Castings: ASTM A 48, Class 30.
 8. Malleable Iron Castings: ASTM A 47, grade 32510.
 9. Brackets, Flanges and Anchors: Metal to match material and finish of supported rails, or as noted.
 10. Concrete Inserts: Threaded or wedge type; galvanized ASTM A 47 malleable iron or ASTM A 27 cast steel castings. Provide ASTM A 153 hot-dip galvanized bolts, washers, and shims as required.
 11. Welding Rods and Bare Electrodes: Select as per AWS specifications for the metal alloy to be welded.
 12. Fasteners: General: Provide Torx-head (star design with center reject pin) security fasteners for anchoring work in exposed security areas. Provide one hundred (100) additional security glazing stop fasteners.
 13. Shop Primer for Ferrous Metal (alkyd based): Manufacturer's or fabricator's standard, fast-curing, lead-free, universal modified alkyd primer selected for resistance to normal atmospheric corrosion, for compatibility with finish paint systems indicated, and for capability to provide a sound foundation for field-applied topcoats despite prolonged exposure complying with performance requirements of FS TT-P-645. If the Shop Primer described above is provided instead of the Phenolic-Phosphate based water primer described in item No. 13 below, then all interior surfaces of the hollow metal frame assembly's jambs, heads and sills are to receive a coating of water based coating of Aqueous Automotive Corrosion Control Coating Terotex No. 895213 by Henkel Surface Technologies (or equal).
 14. Shop Primer for Ferrous Metal: Interior doors and frames shall be thoroughly cleaned, degreased, bonderized, and provided with one coat of North American Technologies No. 40-P-1802 (or equal) primer.
 - a. PRIMER Specifications:
 - 1) Phenolic Water Based Primer
 - 2) Product Number: 40-P-1802
 - 3) Description: Phenolic phosphate-based water primer designed for use in extremely corrosive building applications.
 - 4) Application: Apply by brush, roller, spray, or dip.
 - 5) Percent solids per weight: 50 percent +/- 2

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- 6) Weight/Gallon; 8.93
- 7) PVC: 39 percent
- 8) Gloss 60 degree: 0 degree
- 9) Salt Spray: 200 hours @ 1.5m
- 10) Recommended Film Thickness: 0.8 – 1.5m
- 11) Color: Gray or Beige
- 12) Rust Inhibitive Pigment: Zinc Phosphate
- 13) Application Use: Primer shall be used over properly cleaned, rust free steel for proper rust inhibition. Steel should be stored in a dry environment, protected from damage to surface. Steel must be top coated within one (1) month of arrival with any commercially available top coat, water based or solvent based.

2.3 FABRICATION

- A. Form metal fabrications from materials of size, thickness, and shapes indicated but not less than that needed to comply with performance requirements indicated. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support. Use type of materials indicated or specified for various components of each metal fabrication.
- B. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
- C. Shear and punch metals cleanly and accurately. Remove burrs.
- D. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Remove sharp or rough areas on exposed traffic surfaces.
- F. Weld corners and seams continuously to comply with AWS recommendations and 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 that no roughness shows after finishing, and contour of welded surface matches those adjacent.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type indicated or, if not indicated, Torx-head flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.
- H. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to provide adequate support for intended use.
- I. Shop Assembly:
 - 1. Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for

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reassembly and coordinated installation. Cut, reinforce, drill, and tap fabricated work as indicated to receive finish hardware, screws, and similar items.

2. Fabricate steel door and frame units to be rigid, neat in appearance, and free from defects, warp, or buckle. Accurately form metal to required sizes and profiles as indicated on drawings.
3. After fabrication, interior and exterior doors and frames shall be thoroughly cleaned, degreased, bonderized, and provided with one coat of shop primer.
4. Fabricate exterior doors, panels, and frames from galvanized sheet steel.
5. Clean, treat, and paint exposed, galvanized surfaces of fabricated hollow metal units.

J. Finish Hardware and Security Items Preparation:

1. Templates for all hardware attachments and security items shall be provided by the hardware suppliers to the Detention Equipment Contractor (DEC) for transmittal to the frame and door manufacturer.
2. Fabricate frames with mitered corners, welded continuously and ground smooth. Frames and doors shall be mortised, reinforced, machined, and prepared for all hardware.

2.4 HOLLOW METAL DOORS

- A. Provide hollow metal doors of the types and styles indicated on the drawings and schedules. Furnish detailed accessory items such as food pass.
- B. All hollow metal doors shall have a flush closed top edge and bottom edge.
- C. Size/Thickness/Type: Refer to Detention Door Schedule and Detention Door Types.
- D. Gauge: 14 gauge face sheets.
- E. Coordinate electric hardware requirements to be integrally built into the door with the hardware requirements.
- F. Internal Core Construction: Provide one of the following two (2) types:
 1. Steel-Stiffened Core: Steel stiffened by continuous vertically formed steel hat sections, which upon assembly, shall span the full thickness of the interior space between door faces. Stiffeners shall be 16 gauge (minimum) to meet the performance standards established in the quality control section of this specification, spaced such that the vertical interior webs shall be no more than 4 inches o.c. and securely fastened to both face sheets and together by spot welds spaced a minimum of 2-1/2 inches o.c. vertically. Spaces between stiffeners shall be filled with 3 lbs./cu. ft. fiberglass or mineral Rockwool batt-type material.
 2. Truss-Stiffened Core: Continuous, inner-reinforcement full height and width shall be true truss design with triangular form, the shape of which cannot be altered without changing the length of the sides. Flat apexes shall be resistance spot welded on 2-3/4 inch centers horizontally and 3 inch centers vertically. Each flute of reinforcement to be fire and sound insulated with 6 lbs./cu. ft. Rockwool batt-type material.
- G. Top and Bottom Channels: The top and bottom edges shall be closed with a continuous channel, not less than 12 gauge, welded to both face sheets at a minimum of 4 inches o.c. Reinforce the top closing end channel with an additional 12 gauge flush closing channel full width continuously welded to the vertical edge of the door at all four corners and at the center.
- H. Vertical Edges:

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1. All vertical edges shall be reinforced by a continuous steel channel, not less than 12 gauge, extending the full length of the door. Continuously weld and finish smooth edge seams without visible joints or seams on exposed faces or stile edges.
 - a. For single-acting swinging detention doors, lock and hinge edges shall be beveled 1/8 inch in 2 inches.
 - b. For sliding detention doors, square both vertical edges.
 - I. Exterior Doors:
 1. Fabricate exterior doors of two outer, galvanized, stretcher-leveled, steel sheets. Construct doors with smooth, flush surfaces without visible joints or seams on exposed faces or stile edges, except around glazed or louvered panel inserts. Provide weep hole openings in the bottom of exterior doors to permit the escape of entrapped moisture.
 - J. Interior Doors.
 1. Fabricate interior doors of two outer, cold-rolled, stretcher-leveled, steel sheets. Construct doors with smooth, flush surfaces, without visible joints or seams on exposed faces or stile edges.
 - K. Finish Hardware Reinforcement:
 1. Hinges: Steel plate 3/16 inch thick by full height, secured by spot-welds 4 inches o.c.
 2. Mortise Locksets and Dead Bolts: 3/16 inch thick steel sheet, welded to inside of door on detention side (cell side) and 3/16 inch thick steel lock mounting plate, beveled at edges, applied to the surface of the door with security screws.
 3. Cylinder Locks: 12 gauge steel sheet, secured with not less than 2 spot-welds.
 4. Flush Bolts: 12 gauge steel sheet, secured with not less than 2 spot-welds.
 5. Surface-Applied Closers: 12 gauge steel sheet, secured with not less than 6 spot-welds.
 6. Push Plates and Bars: 16 gauge steel sheet (except when through bolts are indicated or specified), secured with not less than 2 spot-welds.
 7. Automatic Door Bottoms: Reinforce for mortise-type units with 12 gauge steel, and 16 gauge for surface-applied units.
 8. Vision Panels: 12 gauge steel sheet around perimeter, welded 3 inches o.c. field installed.
 - L. Removable glass stops shall consist of 10 gauge "Z"-type stops securely fastened to the door using Torx-head (star with center reject pin) security screws of the size, strength and spacing necessary to satisfy impact performance criteria.
- 2.5 HOLLOW METAL FRAMES
- A. Provide custom/security hollow metal door frames of the types and styles indicated on the drawings and schedules, interior and exterior. Conceal all anchorage, unless noted otherwise.
 - B. Provide custom/security hollow metal frames for windows, transoms, side lites, borrowed lites, and other openings as indicated on the drawings, interior and exterior. Conceal all anchorage, unless noted otherwise.
 - C. Provide galvanized frames at exterior locations and as indicated in the Detention Door Schedule.
 - D. Fabricate frames with mitered corners continuously welded through head inside corner and miter ground smooth.

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- E. All frames shall be provided with approved jamb anchors (4 per jamb minimum), floor knees, plaster boxes (26 gauge steel minimum), removable angle spreaders, and door silencers (3 Glynn Johnson GJ64 silencers minimum per door) by the manufacturer. Continuous floor anchors below glazing shall be 12 gauge minimum with holes for fasteners at 12 inches on center.
- F. Types: Refer to Detention Door Schedule and Detention Frame Elevations.
- G. Gauge: 12 gauge.
- H. Finish Hardware Reinforcement: Reinforce frames for required finish hardware, as follows:
 - 1. Hinges and Pivots: Hinge Reinforcing Steel plate 3/16 inch thick by 2 inches wide by 10 inches long welded to the inside of the frame and a Back-Up Angle 3/16 inch thick welded to the Hinge Reinforcement steel plate and to the frame at both its ends. Back-Up Angle shall be drilled and tapped to accommodate security screws to fasten the security hinges.
 - 2. Strike Plate Clips: Steel plate 3/16 inch thick by 1-1/2 inches wide by 3 inches long.
 - 3. Surface-Applied Closers: 12 gauge steel sheet, secured with not less than 6 spot-welds.
 - 4. Provide lock pockets as indicated and required.
- I. Removable glass stops shall consist of 10 gauge angles securely fastened to the frame using Torx-head (star with center reject pin) security screws of the size, strength and spacing necessary to satisfy impact performance criteria. During shipment of these assemblies, non-security fasteners may be substituted to hold glass stops in place. The security fasteners shall be included in the same shipment but packaged separately for protection until used to stop in the required glazing.
- J. Provide grout openings for all vertical or horizontal hollow metal frame sections that are not accessible for grouting due to steel lintels or other obstructions.
- K. Provide separate conduit systems for door control, intercom, etc., within hollow metal frames.
- L. Coordinate rabbet width between fixed and removable stops with glass or panel type and installation type indicated.

2.6 DETENTION HOLLOW METAL PANELS

- A. Provide fixed detention panels of same materials, construction, and finish as specified for adjoining detention door.

2.7 ELECTRICAL REQUIREMENTS

- A. Custom/security hollow metal fabricator shall furnish and install junction boxes and conduit between junction boxes in door frames for electric locks, door position switches, emergency release buttons, and intercom call stations; coordinate special hardware requirements with the Electrical Contractor and Security Hardware Subcontractor.
- B. Refer to the Detention Door Schedule(s), Security Hardware Specification Section, and Details.

2.8 SECURITY/DETENTION EQUIPMENT ACCESSORIES

- A. Provide accessories, anchorage inserts, and security fasteners for a complete, tamperproof installation.

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B. Exposed Security Fasteners:

1. Provide Torx-head (star design with center reject pin) security fasteners for anchoring work in exposed security areas. Provide one hundred (100) additional security glazing stop fasteners.
2. Finish shall match that specified of the item anchored.
3. Provide three (3) sets of tools for each type of security fastener used.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the areas and conditions under which steel doors and frames are to be installed. Notify the Contractor in writing of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

- A. Install hollow metal units and accessories in accordance with final shop drawings and manufacturer's data, and as herein specified.

B. Placing Frames:

1. Comply with the provisions of S.D.I. 105.
2. Place frames prior to construction of enclosing walls and ceilings. Set frames accurately in position, plumbed and aligned (using metal shims), and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged.
3. Identify and coordinate with the work of Section 079200 – Joint Sealants to assure the 'Filling of all Voids' around the perimeter of custom/security hollow metal frames. Refer to specification Section 079200 – Joint Sealants and its article on Security Sealants for types of sealants to be utilized.
4. Install fire-rated frames in accordance with NFPA 80.
5. Grout fill solid all custom/security hollow metal frame jambs, sill, and head sections. Provide grout openings in hollow metal frames where access for grout filling of frame sections may be restricted due to steel lintels or other obstructions. Prior to filling jamb, head, and sill frame sections with grout, verify that the required Phenolic Water Based Primer has properly coated all interior surfaces. If the primer coating is omitted or damaged, field apply a coating of the Phenolic Water Based Primer.
6. If the supplied Shop Primer is a universal modified alkyd primer, instead of the Phenolic-Phosphate based water primer, below, then all interior surfaces of the hollow metal frame assembly's jambs, heads, and sills are to receive a coating of water-based coating of Aqueous Automotive Corrosion Control Coating Terotex No. 895213 by Henkel Surface Technologies (or equal).
7. Prior to filling intermediate frame sections with grout, verify that the required Phenolic Water Based Primer has properly coated all interior surfaces. If the primer coating is omitted or damaged, field apply a coating of the Phenolic Water Based Primer.

NOTE: If the supplied Shop Primer is a universal modified alkyd primer, instead of the Phenolic-Phosphate based water primer, below, then all interior surfaces of the hollow

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metal frame assembly's jambs, heads and sills are to receive a coating of water based coating of Aqueous Automotive Corrosion Control Coating Terotex No.895213 by Henkel Surface Technologies (or equal).

8. In masonry construction, locate a minimum of four (4) wall anchors per jamb at hinge and strike levels. Setting of anchors and grout filling of frame jambs is specified in Division 4 Sections "Unit Masonry" and "Reinforced Unit Masonry" as applicable.

C. Door Installation:

1. Fit non-fire-rated custom/security hollow metal doors accurately in their respective frames with the following clearance tolerances or as indicated on the Detention Door Schedule (utilize clearances specified in S.D.I. 100 for applications not listed below):
 - a. Jambs and Head: 1/8 inch +/- 1/16"
 - b. Meeting Edges, Pair of Doors: 1/8 inch +/- 1/16"
 - c. Bottom: 3/8 inch (when no carpet or threshold). When bottom gap exceeds 3/8" at cell doors, provide an accessory steel plate to close the gap to 3/8". Refer to Section 111960 and detail on Drawing A3.3.1.
 - d. Bottom: 1/8 inch (when having carpet or threshold)
2. Sliding Detention Doors: Fit sliding detention doors in their frames according to manufacturer's written instructions and as required to allow doors to slide without binding.
3. Install fire-rated doors per NFPA 80 (or per local applicable codes, if more stringent).

- D. All expenses incurred by the Architect in troubleshooting the Custom / Security Hollow Metal Work, caused by inadequate workmanship or other form of non-performance on the part of the subcontractor, shall be borne by that subcontractor.

3.3 ADJUST AND CLEAN

A. Final Adjustments:

1. Check and readjust operating finish hardware items in hollow metal work immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including detention doors or frames which are warped, bowed, or damaged or otherwise unacceptable.

- B. Clean grout and other bonding material off detention doors and frames immediately after installation.

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

D. Prime Coat Touchup:

1. Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.
2. After finishing smooth field welds, apply air-drying primer.

END OF SECTION 111910

SECTION 111950 - SECURITY GLASS AND GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUMMARY

- A. Detention Equipment Contractor (DEC):
 - 1. Provide security glass and glazing work as indicated.
 - 2. Applications of security glass and glazing include the following:
 - a. Security glazing of interior and exterior doors.
 - b. Security glazing of interior and exterior hollow metal frames and miscellaneous interior security glazed frames.
 - c. Insulating security glazing in exterior openings
- B. General Contractor:
 - 1. Coordinate efforts of security glazing with other glazing work and the installation of security hollow metal work.

1.3 GLAZING CRITERIA PERFORMANCE REQUIREMENTS

- A. Security Glass:
 - 1. Comply with multiple impact and high energy impact tests:
 - a. UL 972.
 - b. ASTM F 1233.
 - c. ASTM F 1915.
- B. Bullet Resistant Glass:
 - 1. Comply with UL 752. Provide glazing listed and labeled by UL for the required rating.
- C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated:
 - 1. Design Procedure for Glass: ASTM E 1300 and ICC's International Building Code.
 - 2. Design Wind Pressures: As indicated on Drawings.
- D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with Safety Standard for Architectural Glazing Materials; 16 CFR Part 1201, Category II.
- E. Security Polycarbonate:
 - 1. Comply with ASTM F 1233 containment test body passage or contraband passage level as described in Security Glazing "Compositions" section.
 - 2. Comply with ASTM F 1915 containment test using pendulum impact having blunt, sharp and axe heads with heat /fire (torch) applied.
 - 3. Bullet resistant products shall be tested and listed by UL 752 or ASTM F 1233, whichever is applicable and certified to by the manufacturer of the security glazing.
 - 4. Maintenance serviceability test, all types:
 - a. Products will not exhibit abrasion haze of more than 15 percent when tested to ANSI Z26.1. Taber Abrader test No. 17 for 100 cycles having a 500 gram load.

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- b. No extraordinary procedures shall be required for window cleaning. Manufacturer's recommendations shall be followed.
 - F. Experience Criteria:
 - 1. Minimum of five (5) years' experience manufacturing specified item.
 - 2. Minimum of five (5) years successful installations on detention and correctional facilities.
 - 3. Security glazing manufacturer approval:
 - a. No security glazing manufacturers will be approved after the bid date. All manufacturers must submit qualifications to the Architect for consideration no less than fifteen (15) days prior to bid date.
- 1.4 ACTION SUBMITTALS:
- A. Required submittals for this section shall be submitted as one complete package. This shall include, but not be limited to, manufacturer's data, shop drawings, and samples. Failure to do so will result in the submittal being "Rejected" and returned.
 - B. Manufacturer's Data – Glass and Glazing:
 - 1. Submit one (1) reproducible (digital format) copy of manufacturer's specifications and installation instructions for each type of glass, setting blocks, sealants, and gaskets required.
 - 2. Include test data substantiating that glass complies with specified requirements.
 - 3. Indicate by copy of transmittal that Glazier has received copy of handling and glazing instructions.
 - C. Manufacturer's Data - Glazing Materials:
 - 1. Submit one (1) reproducible (digital format) copy of manufacturer's specifications and installation instructions for each type of glazing, sealant, tape, compound, gasket and associated miscellaneous material required. Include manufacturer's published data, letter of certification, or certified test laboratory report indicating that each material complies with the requirements as is intended generally for the applications indicated.
 - 2. Indicate by copy of transmittal that Glazier has received copy of each glazing component's recommended installation instructions.
 - D. Shop Drawings:
 - 1. Submit FULL SCALE hollow metal sill glazing installation detail drawings. Details shall indicate the actual glazing products being supplied (i.e. setting blocks, sealants, gaskets), their actual sizes, their placements/spacing and their dimensional relationships within the assembly.
 - a. Provide details for fire-rated and non-fire-rated security glazing.
 - b. Provide details for exterior security glazing.
 - E. Security Glazing Schedule: List glazing types for each opening and location. Use same designations indicated on Drawings.

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- F. Glazing Samples: For the following products; 12 inches square, two (2) samples of each type:
 - 1. Type INSG-1.
- G. Shading Film product data and samples: Submit one (1) reproducible (digital format) copy of manufacturer's data and two (2) sets of samples of interior-applied, shading "Films" being considered for glazing types indicated to receive it (refer to Security Glazing types).
- H. Sample Warranties: For security glazing.

1.5 JOB CONDITIONS

- A. Weather Conditions:
 - 1. Do not proceed with installation of liquid sealants under adverse weather conditions, or when temperatures are below or above manufacturer's recommended limitations for sealant installation.

1.6 WARRANTY

- A. Security Glass:
 - 1. Provide Owner a five (5) year guarantee for materials and labor from date of Substantial Completion for all security glazing.
 - 2. Guarantee shall include delamination.
 - 3. The guarantee shall be by the manufacturer, co-signed by the Installer and Detention Equipment Contractor.
 - 4. Manufacturer's warranty on laminated polycarbonate:
 - a. Provide written warranty by the manufacturer of mar-resistant laminated polycarbonate agreeing to supply replacement product, FOB point of manufacture, freight allowed to project site, in the event of material failure due to manufacturing defect. Defect shall be defined as edge separation, delamination, breakage, or coating failure. Time period for said warranty shall be a minimum of five (5) years.

PART 2 - PRODUCTS

2.1 GLAZING TESTING CRITERIA

- A. Security Glazings:
 - 1. Comply with ANSI standard Z-97.1-2009 Safety Glazing Materials Used in Buildings—Safety Performance Specifications and Methods of Test.
 - 2. Comply with and pass UL multiple impact test.
 - 3. Comply with and pass UL high energy impact test.
 - 4. Comply with ASTM F1915 Standard Test Methods for Glazing for Detention Facilities.
- B. Security Polycarbonates:
 - 1. Types: Laminated or monolithic polycarbonate sheet shall be extruded sheet, UV stabilized, but when laminated uses a interlayer of 0.030 inch "LR" resin. Material layups will vary according to manufacturer's requirements to meet constructions listed in Security Glazing Compositions section. Polycarbonate laminates shall have a flexural strength not less than 13,500 psi (ASTM D790, 180 degrees F continuous service temperature).

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Products must conform to the International Building Code (IBC) as an approved light transmitting plastic with a CC-1 flammability performance rating.

C. **APPROVED MANUFACTURERS: (SUBJECT TO COMPLIANCE WITH PERFORMANCE)**

1. Global Security Glazing; Selma, AL
2. DLUBAK Corp; Blairsville, PA
3. LTI Group; Pittsfield, MA
4. McGrory Glass; Paulsboro, NJ

2.2 **SECURITY GLAZING COMPOSITIONS**

A. **Security Insulating-Glass Units:**

1. Provide factory-assembled units, consisting of sealed lites of glazing material indicated separated by a dehydrated interspace, qualified according to ASTM E 2190.
2. **Type INSG-1:** Outdoor lite is made of monolithic glass and indoor lite is made of glass-clad polycarbonate. 1-3/4" inch nominal, Low-E coated tinted insulating glass unit; outdoor lite is 1/4" Kind FT (fully tempered) gray tinted float glass with Low-E coating on second surface, 1/2" insulating air space, indoor lite shall be Security Glazing Type SG-11 – refer to 2.2.C.2 below. Low-E coating shall match Glass Type G-2, as specified in Section 088000.

B. **Polycarbonate Sheet Glazing:**

1. **Type SG-1P** – 3/4 inch nominal, multi-ply clear polycarbonate, ASTM F1915 Grade 1, 60 minute containment rated; Global Security Glazing RC 750 or approved equal.
2. **Type SG-2P** – 1/2 inch nominal, multi-ply clear polycarbonate, ASTM F1915 Grade 2, 40 minute containment rated; Global Security Glazing MPC 500 or approved equal.
3. **Type SG-3P** - 3/8 inch nominal, multi-ply clear polycarbonate, ASTM F1915 Grade 3, 20 minute containment rated; Global Security Glazing MPC 375 or approved equal.

C. **Glass Clad Polycarbonates:**

1. **Type SG-10** – 1 inch nominal, 1/8 inch heat strengthened glass, 1/4 inch clear polycarbonate, 3/8 inch clear polycarbonate, 1/8 inch heat strengthened glass, Apply the shading "Film" on the glazing surface away from the inmate occupancy and after the building has received its Certificate of Occupancy. The shading "film" color is to be selected by the Owner under the supervision of the Architect. ASTM F 1915 Grade 1, 60 minute containment rated; Global Security Glazing SP028 or approved equal.
2. **Type SG-11** - 15/16 inch nominal, 1/8 inch heat strengthened glass, 1/8 inch clear polycarbonate, 1/4 inch clear polycarbonate, 1/8 inch clear polycarbonate, 1/8 inch heat strengthened glass. ASTM F1915 Grade 2, 40 minute containment rated; Global Security Glazing 2114 or approved equal.
3. **Type SG-12** – 3/4 inch nominal, 1/8 inch heat strengthened glass, 1/8 inch clear polycarbonate, 1/4 inch clear polycarbonate, 1/8 inch heat strengthened glass with mirror pane. ASTM F 1915 Grade 2, 40 minute containment rated; Global Security Glazing Secur-Tem + Poly SP019 or approved equal.

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4. **Type SG-13F** – 1-3/4” nominal thickness; Proprietary multi-layer construction comprised of glass-clad polycarbonate and fire-resistant glass laminate. Apply the shading “Film” on the glazing surface away from the inmate occupancy and after the building has received its Certificate of Occupancy. The shading “film” color is to be selected by the Owner under the supervision of the Architect. 45 minute fire rated, ASTM F1915 Grade 1; Global Security Glazing – Inferno-Lite ULTIMAX 45-SP028-G or INFERNOGARD 45-SP028.
5. **Type SG-14F** - 1-1/8 inch nominal, 1/4 inch wire glass, 1/8 inch clear polycarbonate, 3/8 inch clear polycarbonate, 1/8 inch clear polycarbonate, 1/4 inch wire glass. 45 minute fire rated, ASTM F1915 Grade 1; Global Security Glazing – ICGCP 2416WW.
6. **Type SG-15F** (NOT USED)
7. **Type SG-16F** - 1” nominal, 1/4” wire glass, 1/4” clear polycarbonate, 1/8” clear polycarbonate, 1/4” wire glass. 45 minute fire rated, ASTM F1915 Grade 2; Global Security Glazing – FRP-4540.
8. **Type SG-17F** (NOT USED)
9. **Type SG-18F** – (NOT USED)
10. **Type SG-19F** (NOT USED)
11. **Type SG-20** – 1-1/8” nominal, UL 752 Level 3 Bullet Resistant Glazing; Global Security Glazing – SP311.
12. Wire Glass for Glass-Clad Polycarbonates: Provide square mesh pattern.

D. **“Shading Film” Manufacturers:**

1. Madico Window Films Madico, Inc.; St. Petersburg, FL (727) 327-2544 or (888) 887-2022
2. Aegis Films, Inc.; Norcross, GA (770) 417-1281
3. LLumar Solar Control Window Film; Bassett, VA (276) 629-1711
4. MaxPro Window Films; Whiteville, NC (877) 573-3456
5. Sun Block, Inc.; Midlothian, VA (804) 379-4123
6. X-RAYZ Window Tinting; Charlottesville, VA (434) 296-0176
7. Vista Window Film/CP Films, Inc.; Martinsville, VA (888) 273-4567
8. Film Technologies International, Inc.; St. Petersburg, FL (727) 327-2544

2.3 GLAZING SEALANTS/COMPOUNDS

A. Basic Requirements:

1. Provide black exposed glazing materials, unless another color is indicated, or unless another color is selected by Architect from manufacturer's standard colors.
2. Provide hardness of materials as recommended by the manufacturer for the required application and condition of installation in each case.
3. Provide only compounds known (proven) to be fully compatible with surfaces contacted.

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4. Provide sealants recommended by manufacturer of glazing type specified.
 5. Provide silicone sealant bead along entire glazing perimeter, between glazing and stops (removable and non-removable), installed with a substantial "wash" away from security glazing, providing a watertight seal from detergents and cleaning solutions.
- B. Silicone Rubber Glazing Sealant:
1. Silicon rubber, one part elastomeric sealant, complying with FS TTS001543, Class A. Provide acid-type for porous channel surfaces, and provide non-acid type for porous channel surfaces (where any of the channel surfaces are porous).
- C. Butyl Rubber Glazing Tape:
1. Partly vulcanized, self-adhesive, non-staining, elastomeric butyl rubber tape, 98 percent solids, intended for 35 percent compression, non-appreciable deterioration for 3000 hour test in Atlas Weatherometer.
- D. One Component Urethane Glazing Sealant:
1. Solvent based, one component polyurethane; compounded specifically for glazing; complying with FS TT200230, Class A, Type 11.
- E. Acrylic Latex Glazing Compound:
1. Modified latex rubber and acrylic emulsion polymer, compounded specifically as a glazing sealant with permanent flexibility (non-hardening), non-staining, and non-bleeding.
- F. Butyl Rubber Glazing Sealant:
1. Polymerized butyl rubber compound with inert fillers and pigments, solvent based with 75 percent solids, non-sag, tack-free within twenty-four (24) hours, paintable, non-staining.
- G. Preformed Butyl rubber Glazing Sealant:
1. Tape or ribbon (coiled on release paper) of polymerized butyl, or mixture of butyl and polyisobutylene, compounded with inert fillers and pigments, solvent based with minimum of 95 percent solids, with thread or fabric reinforcement, tack-free within twenty-four (24) hours, paintable, non-staining.
 2. Provide combination type and encased continuous rubber shim, of approximately 50 durometer hardness.

2.4 GLAZING GASKETS

- A. Provide glazing gaskets as recommended by manufacturer.
- B. Structural Rubber Glazing Gaskets:
1. Neoprene extrusions with injection molded corner units, fabricated into frames, with either integral or separate locking strips (zippers); comply with ASTM C542, black.
- C. Molded Neoprene Glazing Gaskets:
1. Molded or extruded neoprene gaskets of the profile and hardness required for watertight construction; comply with ASTM D 2000 designation 2BC 415 to 3BC 620, black.
- D. Polyvinyl Chloride Glazing Gaskets:
1. Extruded, flexible PVC gaskets of the profile and hardness shown, or as required for watertight construction; comply with ASTM D 2287.
- E. Vinyl Foam Glazing Tape:

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1. Closed cell, flexible, self-adhesive, non-extruding, polyvinyl chloride foam tape; recommended by manufacturer for installation of glass, with only nominal pressure in the glazing channel; comply with ASTM D 1667.
- F. Glazing Sealants - Materials specifically for polycarbonates:
 1. General
 - a. Provide products and materials of the type indicated and approved for use with the specified security glass polycarbonate products.
 - b. Comply with recommendations of the manufacturers of each type of glazing material for the storage, installation, and finishing of respective products.
 2. Compatibility
 - a. Install using sealants of proven compatibility with the various surfaces in which they will come in contact with, including all submitted silicones, setting blocks, glazing tape, and edge block materials.
 - b. Provide sealants of the color specified, or from manufacturer's standard as chosen by the Architect.
 3. Materials
 - a. Silicone sealants shall be single component elastomeric silicone complying with the following:
 - 1) FS TT-S-001543A (COM-NBS), Class A, non-sag.
 - 2) ASTM C 920, Type S, Grade NS, Class 50, Use G for high modulus silicone.
 - 3) DOWSIL 995 Silicone Structural Sealant or equal.
 - b. Glazing tape shall be pre-formed polyisobutylene butyl sealant, Tremco 440, Tremco Polyshim II, or equal.
 - c. Setting blocks shall be neoprene or EPDM (70 to 90 durometer) 3 inches to 4 inches long.
 - d. Edge blocks shall be neoprene, EPDM or silicone (40-50 durometers) and of a size and spaced as to prevent lateral movement.

2.5 MISCELLANEOUS GLAZING MATERIALS

- A. Setting Blocks:
 1. Neoprene, 7090 durometer hardness, proven compatible with sealants used.
- B. Spacers:
 1. Neoprene 4050 durometer hardness, with proven compatibility with sealants used.
- C. Compressible Backer Rod:
 1. Closed cell or waterproof jacketed rod stock of synthetic rubber or plastic foam, proven to be compatible with sealants used, flexible and resilient, with 510 psi compression strength for 25 percent deflection.
- D. Self-adhesive, Compressible Filler:
 1. Closed cell, polyvinyl chloride foam compressible filler, size 1/2 inch thick by full depth of intermediate composite tube section; color-black. Provide with pressure sensitive adhesive on one side for attachment to tube section. Compressible filler as manufactured by Tremco.
- E. Cleaners, Primers, and Sealers:
 1. Type recommended by sealant or gasket manufacturer.

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- F. Exposed Security Fasteners:
 - 1. Provide Torx-head (star design with center pin) security fasteners for anchoring work in exposed security areas.
 - 2. Finish shall match that specified of the item anchored. (Do not paint Torx- heads.)
 - 3. Provide three (3) sets of tools for security fasteners.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing and glazing channel surfaces, backing, removable stop design, and the conditions under which the glazing is to be performed. Notify the Architect in writing of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the glazing until unsatisfactory conditions have been corrected.

3.2 STANDARDS AND PERFORMANCE

- A. Watertight and airtight installation of each piece of glass is required, except as otherwise shown. Each installation must withstand normal temperature changes, wind loading, impact loading (for operating sash and doors) without failure of any kind including loss or breakage of glass, failure of sealants or gaskets to remain watertight and airtight, deterioration of glazing materials and other defects in the work.
- B. Protect glass from edge damage during handling, installation and operations of the building.
- C. Glazing channel dimensions are intended to provide for necessary minimum bite on the glass, minimum edge clearance and adequate sealant thicknesses, with reasonable tolerances. The Glazier is responsible for correct size for each opening, with the tolerance and necessary dimensions established.
- D. Comply with combined recommendations of glass manufacturer and manufacturer of sealants and other materials used in glazing, except where more stringent requirements are shown or specified, and except where manufacturer's technical representatives direct otherwise.
- E. Comply with "Glazing Manual" by Flat Glass Marketing Association except as shown and specified otherwise, and except as specifically recommended otherwise by the manufacturers of the glass and glazing materials.
- F. Inspect each piece of glass immediately before installation and eliminate any which have observable edge damage or face imperfections.
- G. Unify appearance of each series of lites by setting each piece to match others as nearly as possible. Inspect each piece and set with pattern, draw and bow oriented in the same direction as other pieces.
- H. Cut and install colored (tinted) glass as recommended in "Technical Services Report No. 104" by PPG Industries.
- I. All expenses incurred by the Architect in troubleshooting the Security Glass and Glazing work, caused by inadequate workmanship or other form of non-performance on the part of the subcontractor, shall be borne by that subcontractor.

3.3 PREPARATION FOR GLAZING

- A. Clean glazing channels and other framing members to receive security glazing, immediately before glazing. Remove coatings not firmly bonded to substrates. Remove lacquer from metal surfaces wherever elastomeric sealants are used.
- B. Apply primer or sealer to joint surfaces wherever recommended by sealant manufacturer.

3.4 GLAZING

- A. Comply with glass, window, and frame manufacturer's recommendations.
- B. Install setting blocks, of proper size, at quarter points of sill rabbet. Set blocks in thin course of the heel bead compound, if any.
- C. Glazing shall be set with equal bearing for entire width.
- D. Provide spacers inside and out, and of proper size and spacing, for all glass sizes larger than 50 inches, except where gaskets are used for glazing. Provide 1/8 inch minimum bite of spacers on glass and use thickness equal to sealant width, except with sealant tape use thickness slightly less than final compressed thickness of tape.
- E. Voids and Filler Rods:
 - 1. Prevent exudation of sealant or compound by forming voids or installing filler rods in the channel at the heel of jambs and head (do not leave voids in the sill channels) except as otherwise indicated, depending on lite size, thickness, and type of glass, and complying with manufacturer's recommendations.
- F. Do not attempt to cut, seam, nip or abrade glazing which is tempered, heat strengthened, or coated.
- G. Force sealants into channel to eliminate voids and to ensure complete "wetting" or bond of sealant to glass and channel surfaces.
- H. Provide silicone sealant bead along entire glazing perimeter, between glazing and stops (removable and non-removable), installed with a substantial "wash" away from the glass, providing a watertight seal from detergents and cleaning solutions.
- I. Clean and trim excess glazing materials from the glass and stops or frames promptly after installation, and eliminate stains and discolorations.
- J. Specific recommendations for polycarbonate glazing installation:
 - 1. Install setting blocks of proper size in sill rabbet, located one quarter of glass width from each corner, but with edge nearest corner not closer than 6 inches from corner unless otherwise required. Set blocks in thin course of sealant.
 - 2. Provide spaces inside and out, of correct size and spacing to preserve required face clearances, for glass sizes larger than 50 inches, except where gaskets or glazing tapes with continuous spacer rods are used for glazing. Provide 1/8 inch minimum bite of spacers on glass and use thickness equal to sealant width, except with sealant tape use thickness slightly less than final compressed tape thickness.
 - 3. Setting blocks, edge blocks, silicone cap beads, glazing tapes/filler rod installation shall comply with GANA (Glass Association of North America) 2008 Edition standards.
 - 4. Tapes and gaskets are to be installed slightly protruded so as to eliminate dirt and moisture pockets. Exposed sealants shall form a wash away from the glazing.

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5. Polycarbonate glazing edge engagements shall generally be 1 inch, unless otherwise approved by the Architect and confirmed by the manufacturer.
6. Expansion allowances for polycarbonate shall generally be 1/16 inch per 12 inches, per 100 degrees F changes in temperature or as approved by the Architect per manufacturer's recommendations.
7. Polycarbonate installation and fabrication shall comply with the written recommendations of the polycarbonate manufacturer. Copies of aforementioned recommendations shall be furnished to the Architect.
8. Install all polycarbonates as late as possible in the construction of the facility. Masking should be removed approximately 1 to 2 inches from the edges so as to allow the glazing tape/silicone to come in contact with the polycarbonate.
9. All polycarbonate lites, exposed to direct sunlight, shall have the masking entirely removed and then securely covered with polyethylene taped to the frames. Failure to remove the masking at this time may result in adhesion of the masking, preventing later removal.
10. Where wedge shaped gaskets are driven into one side of the channel to pressurize the sealant or gasket on the opposite side, provide adequate anchorage to ensure that gasket will not "walk" out when subjected to dynamic movement. Anchor gasket to stop with matching ribs, or by proven adhesive, including embedment of gasket tail in cured heel bead.
11. Glaze units at the building site.

K. Gasket Glazing:

1. Miter cut and bond ends together at corners where gaskets are used for channel glazing, so that gaskets will not pull away from corners and result in voids or leaks in the glazing system.

3.5 CURE, PROTECTION AND CLEANING

- A. Cure glazing sealants & compounds in compliance with manufacturer's instructions and recommendations, to obtain high early bond strength, internal cohesive strength and surface durability.
- B. Protect glass from breakage immediately upon installation, by attaching crossed streamers to framing held away from glass. Do not apply markers of any type to surfaces of glass.
- C. Remove and replace glass which is broken, chipped, cracked, abraded, or damaged in other ways during the construction period, including natural causes, accidents and vandalism.
- D. Maintain glass in a reasonably clean condition during construction so that it will not be damaged by corrosive action and will not contribute (by wash off) to the deterioration of glazing materials and other work.
- E. Polycarbonate materials shall be cleaned using a mild detergent (such as Formula 409) and lukewarm water. Use a clean, soft cloth or sponge, rinse well with clean water.
- F. Paint splashes can be removed using VM&P Naphtha, isopropyl alcohol, or butyl cellosolve, or as otherwise recommended by the glazing manufacturer. Do not use butyl cellosolve in direct sunlight.
- G. DO NOT use abrasives, paint scrapers, razor blades, or squeegees on polycarbonate. Benzene, gasoline, acetone, or carbon tetrachloride should not be used on either polycarbonate or mar resistant polycarbonate.

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- H. Cleaning instruction coordination shall be the responsibility of the general contractor. The glazier manufacturer, painter, and other trades shall be informed of all cleaning instructions.
- I. Wash and polish glass on both faces not more than four (4) before date scheduled for inspections that establish date of Substantial Completion. Comply with security glazing manufacturer's cleaning recommendations. These washing and polishing efforts shall be done by a professional cleaning/custodial firm.

END OF SECTION 111950

SECTION 111960 - SECURITY HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUMMARY

- A. Detention Equipment Contractor (DEC):

1. Provide security hardware as indicated in the schedules and as specified herein.
2. Match existing hardware Southern/Folger and existing keying system.
3. DEC will adjust and test all existing hardware and turnover test reports to GC.
4. Refer to Detention Door Schedule and door details; Custom/Security Hollow Metal Work Section 111910, and Security Control System Section 285000.
5. Coordinate Security Hardware installation with electrical requirements provided by the Electrical Contractor.
6. Make final electrical control hookups at door and control panels.
7. Coordinate all Security Hardware and electrical control needs required with other subcontractors and their equipment to have it function properly from the remote Security Control Consoles (e.g. overhead doors, architectural passage doors).
8. Furnish to the General Contractor any security hardware required for installation on Architectural Hollow Metal doors and frames. Provide necessary templates, etc. for installation.

- B. General Contractor:

1. Coordinate installation of security hardware with DEC, Security Control System Contractor (SCSC) and Electrical Contractor.
2. Install on Architectural doors and frames any required security hardware being provided by the Security Control System Contractor (SCSC).

- C. Electrical Contractor:

1. Coordinate electrical requirements with General Contractor, DEC and SCSC.
2. Provide all security control wiring, conduit, fittings, back boxes, and junction boxes, as directed by Security Control System Subcontractor.
3. Provide all power wiring, conduit, fittings, and mortar boxes as required for equipment described within this section.

1.3 ACTION SUBMITTALS

- A. Required submittal for Security Hardware shall be submitted as a complete package. Failure to do so will result in the submittal being "Rejected" and returned.
- B. Manufacturer's Data:
 1. Submit one (1) reproducible (digital format) copy of product specifications, fabrication and installation instructions for each hardware item used.

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C. Shop Drawings:

1. Shop drawings submittals for Security Hardware shall be submitted as an entire section.
2. Submit one (1) reproducible (digital format) copy of a horizontal hardware schedule, including all miscellaneous items. Give openings by door number and location, manufacturer's names, catalog numbers, keying information, materials, and finish in the scheduling sequence and format as recommended by security hardware manufacturer.
3. The Architect's approval of the hardware schedule will not relieve the Contractor or Supplier of responsibility for errors or omissions that it might contain.
4. A Security Hardware Coordination Conference shall be held and coordinated by the General Contractor after the first Shop Drawing submittal of the Security Hardware. All participants should have at least one (1) week worth of review of this first Shop Drawing submittal and be prepared to comment on its appropriateness for their assigned job efforts.
5. All security keying shall be reviewed with the Owner and approved during the Shop Drawing submittal review meeting.

D. Samples and Templates:

1. Furnish to manufacturer of hollow metal doors and frames as required for proper reinforcement and preparation of their work.
2. If required, the Hardware Supplier shall furnish physical hardware and backboxes to the door and frame manufacturer for inclusion into door and frame fabrications.

E. Security Keying Chart/ Schedule:

1. Submit a Keying Chart schedule after both the Architect and Owner/User have approved the security keying shop drawings. Refer to articles titled "Cylinders, Keys, and Keying" and "Key Control" near the end of this Section.

F. Maintenance Manual

1. Submit two (2) bound Maintenance and Repair Manuals, complete with detailed parts drawings, for all manual and energized security hardware products supplied in this section.
2. Provide on-site review of these manuals and spare parts with the Owner's designated representative during training period. Refer to Article 1.6 "Training" ahead.

G. Refer to Specification Section 111900 for additional submittal requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver all items in manufacturer's original packaging. Individually package and carefully mark each item for intended opening and use. Each item complete with all necessary screws, bolts, keys, instructions, and where necessary, installation templates.
- B. Storage: Store items off floor in dry area of building out of way of other work in progress. Provide maximum protection against loss and damage.
- C. Handling: Handle all items in a manner as to prevent damage.

1.5 GUARANTEE

- A. Upon Final Completion, the Manufacturer/Installer shall provide a written warranty covering the security hardware against defective materials and workmanship and guaranteeing satisfactory operation and performance for a period of one (1) year after Final Completion. The

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Manufacturer/Installer shall make necessary adjustments and replace any defective or broken parts caused by defective mechanical parts.

1.6 TRAINING

- A. Provide two (2) eight-hour days for training of Owner personnel for maintenance and repair of all security hardware. Training shall be at Owner's convenience prior to Final Completion.
- B. Training class and agenda shall include hands-on teaching of repair and maintenance. Contractor shall provide all equipment and tools necessary to conduct training for Owner's personnel.
- C. Training shall be conducted by employee of security hardware manufacturer or factory-authorized service representative with over five years of experience maintaining/repairing locks of the type installed in this facility.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Catalog numbers of the first manufacturer listed have been used to establish the quality required. Other manufacturers seeking approval shall do so in writing per General Requirements and shall list exact catalog numbers and description of the items he proposes to furnish:

ITEM				
1.	Hinges	Southern/Folger	Airteq	Stanley
2.	Stops	Airteq	Northwest	
3.	Holder, Surface Bolts	Glynn-Johnson	Yale	
4.	Push, Pull	Southern/Folger	Airteq	Brink
5.	Thresholds	Pemko	NGP Reese	Zero
6.	Weatherstrip	Pemko	Reese	Zero
7.	Security Locks	Southern/Folger	Airteq	Brink

- B. Designations: Following abbreviations identify listed manufacturers:
 - 1. Southern/Folger Southern/Folger Co.; San Antonio, TX
 - 2. Airteq Cornerstone Detention; Montgomery AL
 - 3. Brink R.R. Brink Lock Systems, Inc.; Shorewood, IL
 - 4. Glynn-Johnson Glynn-Johnson Corp.; Chicago, IL
 - 5. Hager Hager Hinge Co.; St. Louis, MO
 - 6. Ives H. B. Ives Div.; New Haven, CT
 - 7. LCN LCN-Allegion
 - 8. NGP National Guard Products
 - 9. Northwest Northwest Specialty Hdwr Inc.; Clackamas, OR
 - 10. Norton Norton Closer Div.; Charlotte, NC
 - 11. Pemko Pemko Mfg. Co.; Emeryville, CA
 - 12. Reese Reese Enterprises; Rosemount, MN
 - 13. Rockwood Rockwood Manufacturing Co.; Rockwood, PA
 - 14. Stanley Stanley Black & Decker; New Britain, CT
 - 15. Zero Zero Weatherstripping; Bronx, NY

2.2 MATERIALS

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A. Screws, Fasteners, and Tools:

1. Provide exposed fasteners to match material/finish of item being fastened. Make fastener of the same metal as item fastened, except use plated brass or stainless steel for all aluminum items. Provide twenty (20) spares of each type of fastener used for anchoring hardware.
2. Provide Torx-head (with center reject pin) security fasteners for exposed fasteners on all security hardware, regardless of manufacturer. Furnish six (6) tool holders and six (6) bits for each different size screw. Holders and bits shall be left at the project after fastener installation and become the property of the user.
3. Provide two (2) alignment tools for medium security locks.

B. Hinges:

1. Heavy Duty, 4 1/2 FM – ICS:
 - a. Series/Manufacturer:
 - 1) 204 FMSS / Southern Steel Co.
 - 2) 604 FMCS / Airteq
 - 3) No.4 1/2"-ICS Prison / Brink
 - b. Description:
 - 1) 4 1/2 x 4 1/2, 3/16" thick leaves.
 - 2) Cast stainless steel leaves, non-removable stainless steel pins, stainless steel ball bearings, three knuckle with "HT" hospital tips.
 - 3) Provide with a 1/2" long steel stud on each leaf.
 - c. Provide quantities as follows:
 - 1) Doors less than 5 feet high - one pair.
 - 2) Doors over 5 feet to 7 feet 6 inches high - 1-1/2 pairs.
 - 3) Doors over 7 feet 6 inches high - 2 pair
 - 4) Doors 3 feet 6 inches wide and over - 2 pairs.
 - 5) Doors 4 feet 6 inches wide and over – 2-1/2 pairs.
2. Continuous Hinge (Plain Surface Type):
 - a. Series/Manufacturer:
 - 1) 4000 Series / Braun Mfg. Co., Inc. (www.hinge1.com)
 - 2) Approved Equal
 - b. Description:
 - 1) Hinge Leaf material - Cold Rolled Steel
 - 2) Hinge Pin material - Steel
 - 3) Shapes and lengths and gauges to be custom modified as required and/or as indicated on drawings.
 - 4) Provide quantities as indicated on the drawings and hardware sets.
 - 5) Provide USP primed.

C. Door Position Switches:

1. Swing Door Position Switch (Full-Mortise in frame head):
 - a. Series/Manufacturer:
 - 1) 240 CPS/Southern Steel
 - 2) 6200/Airteq
 - 3) 201020/Brink

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- b. Description:
 - 1) Provide a fully-mortised, door-position indication switch for monitoring the positions of a swinging door. Installed unit must be fully concealed when door is closed, and fit into the header of a standard, 2" high door frame. The track shall be self-concealing as the door is opened. Allow the door to swing a full 180 degrees. Provide a UL-listed, single-pole, double-throw type switch (SPDT), rated for 10 amps @ 125 or 250 VAC. Unit shall indicate "opened" when a 3'-0" wide door moves approximately 3/8" away from its stop. Provide a fine adjustment of the indication switch to compensate for variations in field conditions. Design unit to operate mechanically for a minimum of two million cycles.
- 2. Magnetic Switch:
 - a. Series/Manufacturer:
 - 1) 200 MRS TB/Southern Steel Co.
 - 2) 6200/Airteq
 - 3) 201023/Brink
 - b. Mortise installation overhead mounting with switch contacts housed in the door frame and actuating magnet mortised into the top of the door.

D. Security Locks:

- 1. Maximum Security – Solenoid Operation:
 - a. Series/Manufacturer:
 - 1) 10120AE-2/Southern Steel Co.
 - 2) 9912S/Airteq
 - 3) 5026S x MCLH-M/Brink
 - b. Frame mounted 115 VAC, continuous duty solenoid actuated.
 - c. Bolt is retracted by an energized solenoid valve by a push-button at the control panel and remains retracted until door is opened.
 - d. Bolt is retracted manually by key from outside and inside or outside only.
 - e. Provide galvanized at exterior installations.
 - f. Provide interlock feature as required.
 - g. Internal switches monitor status of bolt.
 - h. Provide key cylinder extension where keyed both sides.
- 2. Maximum Security - Motor Operation:
 - a. Series/Manufacturer:
 - 1) 10120AM/Southern Steel Co.
 - 2) 9912M/Airteq
 - 3) 5026M x MCLH-M/Brink
 - b. Frame mounted 24 VDC, continuous duty motor actuated.
 - c. Bolt is retracted by energized motor by a push-button at control panel and remains retracted until door is opened.
 - d. Bolt is retracted manually by key from outside and inside or outside only.
 - e. Provide galvanized at exterior installations.
 - f. Provide interlock feature as required.
 - g. Internal switches monitor status of bolt.
 - h. Provide key cylinder extension where keyed both sides.

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3. Medium Security - Motor Operation:
 - a. Series/Manufacturer:
 - 1) 10300M/Southern Steel Co.
 - 2) 9424/Airteq
 - 3) 3520-300 x ____/Brink
 - b. Security Grade: ASTM F 1577 Grade 1.
 - c. Frame mounted 24 VDC high torque gear motor.
 - d. Latchbolt retracts when motor is energized and remains retracted until the door is opened.
 - e. Mechanically unlocked by key outside and inside or outside only.
 - f. Provide keeper with built-in limit switch; internal switches to monitor status of deadlock.
 - g. Provide interlock features as required.
 - h. Provide key cylinder extension where keyed both sides.

4. Maximum Security - Mechanical Operation:
 - a. Series/Manufacturer:
 - 1) 1080A-2/Southern Steel Co.
 - 2) 5086-K2/Airteq
 - 3) 7086/Brink
 - b. Door mounted, deadbolt.
 - c. Lever tumbler, key outside and inside.
 - d. Supply with hollow metal lock mounting, escutcheons, and security screws.
 - e. Provide keeper with built-in limit switch where scheduled.
 - f. Provide 3/4-inch throw latchbolt
 - g. Provide galvanized at exterior/wet locations.

5. Maximum Security - Mechanical Operation:
 - a. Series/Manufacturer:
 - 1) 1070A-2/Southern Steel Co.
 - 2) 5076-K2/Airteq
 - 3) 7066/Brink
 - b. Door mounted, automatic spring deadbolting.
 - c. Lever tumbler, key outside and inside.
 - d. Supply with hollow metal lock mounting, escutcheons, and security screws.
 - e. Provide keeper with built-in limit switch.
 - f. Provide 3/4-inch throw latchbolt.
 - g. Provide galvanized at exterior/wet locations.

6. Medium Security - Mechanical Operation: Food Pass Lock
 - a. Series/Manufacturer:
 - 1) 1017AM/Southern Steel Co.
 - 2) 5017M/Airteq
 - 3) 7017M/Brink
 - b. Keyed outside only.
 - c. Reverse bolt bevel at food pass locations. Refer to details on Drawings.

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7. Medium Security - Mechanical Operation: Paper Pass Lock
 - a. Series/Manufacturer:
 - 1) 1017AM/Southern Steel Co.
 - 2) 5017M/Airteq
 - 3) 9025/Brink
 - b. Keyed outside only.
 - c. Refer to details on Drawings
- E. **Closers: (Recess Mounted)**
 1. Series/Manufacturers:
 - a. 2210 Series /LCN
 - b. 7970 Series /Norton
 2. Description:
 - a. Provide recessed door head closers unless noted otherwise.
 - b. All door closers shall be by one manufacturer and carry a fifteen (15) year warranty, except electrical components, which will carry a two-year warranty. All door closers shall be inspected, after installation, by a factory representative to insure their proper adjustments and operations.
 - c. Spring power shall be adjustable. Spring power shall provide an opening force range of 8 to 15 pounds from 0 degrees to 90 degrees.
 - d. Closers shall have separate adjustments for latch speed, general speed, and back check.
 - e. Provide accessories required to insure a proper installation.
- F. **Pull Loop:**
 1. Series/Manufacturers:
 - a. 212-C/Southern Steel Co.
 - b. 612/Airteq
 - c. 300021/Brink
 2. Stainless steel. Overall length 8-3/4" x 1-1/2" clearance. Fasteners shall be 2-3/8" - 6 x 3/4" stainless steel Torx-head security screws with center reject pin.
- G. **Pull Flush:**
 1. Series/Manufacturer:
 - a. 214-S/Southern Steel Co.
 - b. 614/Airteq
 - c. 300011/Brink
 2. Stainless steel, 4" wide, 1/8" thick x 5" high. Fasteners shall be 1/4" 20 x 5/16" stainless steel Torx-head security screws with center reject pin.
- H. **Push/Pull Plate:**
 1. Series/Manufacturer:
 - a. 120L/Hager
 - b. 1456/Hiwatha
 - c. 91-RKW/Rockwood
 2. 1/8" thick stainless steel, 3.5" w x 16" h with 7/8" lip projection at bottom. Attach with stainless steel Torx-head security screws with center reject pin.
- I. **Door Stops:**
 1. Series/Manufacturer:
 - a. 650/Airteq (wall or floor)

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- b. 606S/Northwest (wall or floor)
- c. 3001/ Stanley (floor); 3002/ Stanley (wall)
- d. 467/Rockwood (wall or floor)
- 2. Silicone rubber body, 2" diameter. 2-1/2" (3-1/2") high.
- 3. 5/8" x 2-1/2" diameter mounting shank.
- 4. Embedded in wall or floor with epoxy resin adhesive.

J. Thresholds:

- 1. Series/Manufacturer:
 - a. 950/NGP
 - b. 2010_PK/ Pemko
 - c. S257/ Reese
 - d. 566/ Zero
- 2. Provide interior anti-pass thresholds as indicated in the Detention Door Schedule.
- 3. Provide aluminum mill finish, unless noted otherwise.
- 4. Set the aluminum threshold into a full bedding of mastic and secured with stainless steel Torx-head security screws with center reject pin.
- 5. Threshold shall be ADA compliant.
- 6. Threshold shall prevent the passing of paper or other contraband under the door.

K. Thresholds: (Outdoor Rec outer door)

- 1. Series/Manufacturer:
 - a. 271A - 5" x 1/4"/Pemko
 - b. S405A - 5" x 1/4"/Reese
 - c. 545 - 5" x 1/4"/Zero
- 2. Set the aluminum threshold into a full bedding of mastic and secured with stainless steel **Torx-head** security screws with center reject pin.
- 3. Threshold shall be ADA compliant.

L. Weatherstripping/Sound Seals:

- 1. Series/Manufacturer:
 - a. 305CR x 315CN/Pemko
 - b. DS70C x 362/Reese
 - c. 50 x 339 (modified to receive a sweep)/Zero
- 2. Extruded anodized aluminum with neoprene seal, secured with stainless steel Torx-head security screws with center reject pin.

M. Weatherstripping/Sound Seals (Bulb type):

- 1. Series/Manufacturer:
 - a. S88/Pemko
 - b. 5050/NGP
 - c. 188S/Zero
- 2. Self-adhesive silicone rubber perimeter seal.

N. Door Bottom Sweep:

- 1. Series/Manufacturer:
 - a. 345A (9/16" projection x 1-1/2" H)/Pemko
 - b. R199/Reese
 - c. 17/NGP
 - d. 11/Zero

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2. Extruded anodized aluminum, secured with stainless steel Torx-head security screws with center reject pin.

O. Rain Drip:

1. Series/Manufacturer:
 - a. 346C (2-1/2" projection)/Pemko
 - b. R201/Reese
 - c. 16/NGP
 - d. 142A/Zero

P. Automatic Door Bottom:

1. Series/Manufacturer:
 - a. 420ASL/Pemko
 - b. 372/Reese
 - c. 360/Zero
2. Mortised type, cam-actuated drop down silicone seal, with spring mechanism return.

Q. Kickplates:

1. Series/Manufacturer:
 - a. 194S/Hager
 - b. K1050/Rockwood
2. Kickplates shall be 0.050" stainless steel with eased edges. 10" high (except reduce height 1/2" less than bottom rail when required) x 2" less than door width on singles and 1" less on pairs. Fasteners shall be full threaded, oval, undercut, metal screw; Torx-head security screws with center reject pin.

R. Door Silencers:

1. Series/Manufacturer:
 - a. GJ-64/Glynn-Johnson
 - b. 608/Rockwood
 - c. SR64/Ives
2. Provide three (3) silencers per door. Silencer design forms an air pocket to absorb shock and reduce noise of door closing. Once installed, the silencers should be tamper-proof and eliminate door rattle.

S. Security Hardware Finishes:

	<u>U.S. Symbol</u>	<u>ANSI Symbol</u>	<u>Description</u>
1. Hinges, Exterior	US32D	630	Satin Stainless Steel
2. Hinges, Interior	US32D	630	Satin Stainless Steel
3. Locks and Pulls	US26D	626	Satin Chromium
4. Closers	AL	689	Aluminum Painted
5. Push, Kick	US32D	630	Satin Stainless Steel
6. Door Pulls	US32D	630	Satin Stainless Steel
7. Escutcheons	US32D	630	Satin Stainless Steel

2.3 CYLINDERS, KEYS, AND KEYING

- A. The security locks will incorporate three (3) keying systems, one for pin tumbler (mogul cylinder) locks, one for lever tumbler (paracentric) locks, and one for builder's hardware high security six-pin tumbler cylinder locks. Dye stamp each keying system's keys for identification, corresponding to the final/approved Keying Chart.

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1. Review all security keying with Owner for final approval during submittal phase. Match owners existing keying system.
2. Provide a system of keys and matching locks that are color-coded and marked for identification by touch to comply with "sight and touch" requirements in 2018 North Carolina Fire Prevention Code section 403.8.3.4 and 10A NCAC 14J .0405.
3. Key Food Pass locks alike and provide ten (10) keys with dye stamp identification marking.
4. Key Paper Pass locks alike & provide ten (10) keys with dye stamp identification marking.
5. Master key mogul cylinder locks as indicated in Detention Door Schedule and as confirmed with the Owner during the Security Keying Meeting.
6. Provide two (2) keys in each Key Cabinet for all individual key designations.
7. Provide three (3) keys in each Key Cabinet for each Master key designation.
8. Provide a complete, detailed, schematic Keying Chart of the Security Keying System's individual key designations.
 - a. Two (2) copies of this Keying Chart, overlaid on an architectural floor plan print, shall be turned over to the Owner/User at the completion of the project. The cost for Keying Chart shall be included with the cost of materials at the time of bidding.

B. Key Control:

1. Provide one (1) Key Cabinet in [Central Control 153](#). Coordinate exact location with Owner and other equipment to be wall-mounted in the control room.
2. Key Cabinet (wall mounted, surface):
 - a. Key Control system shall be furnished with a capacity of 1.75 times the number of individual key designations and shall be a complete dual tag system.
 - b. Key Cabinet shall have concealed-type hinge and rounded sides.
 - c. Panels must have individual hooks and label pockets formed as an integral part of the panel, for each key type, as required. (i.e. paracentric, P-_; mogul, M-_; builders hardware, B-).
 - d. Key Tags of two (2) types shall be provided, one tag to attach to the individual key designations that permanently stays in the key cabinet and one tag to attach to the individual key designation that is loaned out.
 - e. Indexing shall be provided to record information concerning locks and keys alphabetically.
 - f. Permanent Loan Registry shall be furnished to protect identity of key borrowers while Receipt Tabs shall be supplied for temporary loan.
3. Keys shall not leave the manufacturer's custody without prior arrangements for delivery and authorization from the Owner.

2.4 SECURITY HARDWARE SETS FOR SECURITY/DETENTION DOORS

A. Provide security hardware equal to items scheduled. Verify electrical devices are appropriate for models indicated. Electrical control connections are included in work of Section 285000 "Security Control System."

1. Smoke seals and automatic door bottoms shall be added to all doors in smoke barriers as required to meet smoke and fire ratings per UL 1784.
2. **Food Pass**
 - a. All doors indicated with food passes in the Options column of the Detention Door Schedule shall have the following additional hardware:

1	Braun Hinge – 4807-E
1	Food Pass Lock, Southern Steel 1017AM

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B. Security Hardware Sets Schedule:

HARDWARE SET NO	QUANTITY	CLASS	DESCRIPTION
SH1	3 or 4	Hinges	SS 204FMSS
	1	Lock	SS 10120AE x K2 x KCE
	2	Loop Pulls	SS 212C
	1	Door Closer	LCN 2210
	1	Door Position Switch	SS 200MRS TB
	1	Door Bottom Sweep/Rain Drip	Pemko 345A
	1	Threshold	Pemko 2010 PK
	1	Door Stop	Airteq #650
	1	Kickplate	Rockwood K1050
	1	Auto Bottom	Pemko 420ASL
	1	Weatherstrip	Pemko 305CR
SH1A	3 or 4	Hinges	SS 204FMSS
	1	Lock	SS 10120AE x K2 x KCE
	1	Loop Pull	SS 212C
	1	Flush Pull	SS 214S
	1	Door Closer	LCN 2210
	1	Door Position Switch	SS 200MRS TB
	1	Door Bottom Sweep/Rain Drip	Pemko 345A
	1	Threshold	Pemko 2010 PK
	1	Door Stop	Airteq #650
	1	Auto Bottom	Pemko 420ASL
	1	Weatherstrip	Pemko 305CR
SH1B	3	Hinges	SS 204FMSS
	1	Lock	SS 10120AE x K2 x KCE
	1	Loop Pull	SS 212C
	1	Flush Pull	SS 214S
	1	Door Closer	LCN 2210

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	1	Door Position Switch	SS 200MRS TB
	1	Door Bottom Sweep	Pemko 345A
	1	Threshold	Pemko 271
	1	Door Stop	Airteq #650
	1	Auto Bottom	Pemko 420ASL
SH2	3 or 4	Hinges	SS 204FMSS
	1	Lock	SS 10120AM x K2 x KCE
	2	Loop Pull	SS 212C
	1	Door Closer	LCN 2210
	1	Door Position Switch	SS 200MRS TB
	1	Door Stop	Airteq #650
	2	Kickplate	Rockwood K1050
	1	Auto Bottom	Pemko 420ASL
	1	Weatherstrip	Pemko 305CR
SH2A	3 or 4	Hinges	SS 204FMSS
	1	Lock	SS 10120AM x K2 x KCE
	1	Loop Pull	SS 212C
	1	Flush Pull	SS 214S
	1	Door Closer	LCN 2210
	1	Door Position Switch	SS 200MRS TB
	1	Door Stop	Airteq # 650
	1	Auto Bottom	Pemko 420ASL
	1	Weatherstrip	Pemko 305CR
SH3	3	Hinges	SS 204FMSS
	1	Lock	SS 10120AM x K1
	1	Loop Pull	SS 212C
	1	Flush Pull	SS 214S
	1	Door Position Switch	SS 200MRS TB
	1	Door Stop	Airteq # 650

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	3	Silencers	Rockwood 608
SH4	3	Hinges	SS 204FMSS
	1	Lock	SS 10120AM x K2 x KCE, Provide no mechanical latch hold back function
	2	Loop Pull	SS 212C
	1	Door Closer	LCN 2210
	1	Door Position Switch	SS 200MRS TB
	1	Door Stop	Airteq #650
	1	Kickplate	Rockwood 1050
	1	Auto Bottom	Pemko 420ASL
	1	Weatherstrip	Pemko 305CR
	1	Jamb-mounted Push Button (for local lock operation)	Airteq # 6300 (mount inside Control Room)
SH5	3	Hinges	SS 204FMSS
	1	Lock	SS 10120AM x K1
	1	Loop Pull	SS 212C
	1	Flush Pull	SS 214S
	1	Door Closer	LCN 2210
	1	Door Position Switch	SS 200MRS TB
	1	Door Stop	Airteq #650
	1	Kickplate	Rockwood 1050
	1	Auto Bottom	Pemko 420ASL
	1	Weatherstrip	Pemko S88
SH6	1	Corridor Sliding Device	SS 3165LX.bPKM-2 (Emergency Manual Key Release, electric keyswitch Mogul K2)
	1	Loop Pull	SS 212C
	1	Flush Pull	SS 214S
	1	Weatherstrip	Pemko 332CR
	1	Door Skirt	

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SH6A	1	Corridor Sliding Device	SS 3165LX.bPKM-2 (Emergency Manual Key Release, electric keyswitch Mogul K2)
	1	Loop Pull	SS 212C
	1	Flush Pull	SS 214S
	1	Emergency Pushbutton	Airteq #6300 (each side)
	1	Weatherstrip	Pemko 332CR
	1	Weatherstrip (Door Sweep)	Pemko 18061 CNB
		<u>Emergency Pushbutton shall only close door after door is activated by the Emergency Release function specified in Section 285020. Pushbutton shall not otherwise be active</u>	
SH7	3	Hinges	SS 204FMSS
	1	Lock	SS 10300M x K2 x KCE
	1	Loop Pull	SS 212C
	1	Flush Pull	SS 214S
	1	Door Closer	LCN 2210
	1	Door Position Switch	SS 200MRS TB
	1	Door Stop	Airteq #650
	1	Kickplate	Rockwood 1050
	1	Auto Bottom	Pemko 420ASL
	1	Weatherstrip	Pemko S88
SH7A	3	Hinges	SS 204FMSS
	1	Lock	SS 10300M x K2 x KCE
	2	Loop Pull	SS 212C
	1	Door Closer	LCN 2210
	1	Door Position Switch	SS 200MRS TB
	1	Door Stop	Airteq #650
	1	Kickplate	Rockwood 1050

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	1	Auto Bottom	Pemko 420ASL
	1	Weatherstrip	Pemko S88
	1	Jamb-mounted Push Button (for local lock operation)	Airteq # 6300 (mount inside room)
SH8		(NOT USED)	
SH9	3	Hinges	SS 204FMSS
	1	Lock	SS 1080A x K2
	1	Keeper	SS 470CL
	2	Loop Pull	SS 212C
	1	Door Position Switch	SS 200MRS TB
	1	Door Bottom Sweep/Rain Drip	Pemko 345A
	1	Threshold	Pemko 2010 PK
	1	Auto Bottom	Pemko 420ASL
	1	Weatherstrip	Pemko 305CR x 315CN
	1	Door Stop	Airteq No.650
	1	Escutcheon	SS 218
	1	Cylinder Shield	SS 219
SH10	3	Hinges	SS 204FMSS
	1	Lock	SS 1070A x K2
	1	Keeper	SS 470CL
	2	Loop Pull	SS 212C
	1	Door Closer	LCN 2210
	1	Door Position Switch	SS 200MRS TB
	1	Auto Bottom	Pemko 420ASL
	1	Weatherstrip	Pemko 305CR
	1	Door Stop	Airteq No.650
	2	Escutcheon	SS 218
SH11		(NOT USED)	

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SH12	1	Lock	SS 1050D Gate Lock x K2
	1	Gate Position Switch	GE 2707A
	1	Self-closing Hinge	Coordinate with gate supplier

C. Security Spare Locks and Lock Parts:

1. Provide the following for the Owner's stock:
 - a. 0 Lock 10120AE
 - b. 0 Locks 10120AM
 - c. 0 Lock 10300M
 - d. 0 Lock 1080A
 - e. 1 Lock 1070A
 - f. 2 Mogul Cylinders
 - g. 0 Builders Cylinders
2. One each repair parts kit for each lock series, containing springs, micro switches, screws, nuts and washers.
3. One parts kit containing an assortment (minimum 25) of all hardware security screws used on this project.
4. One complete set of hardware security screwdrivers for all sizes of hardware security screws used on this project.
5. One repair parts list and assembly drawings bound in a manual for all security products supplied in this section.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors, frames and hardware for damage, defects, and suitability for intended use. Restore all parts or items found damaged, defective, or inadequate, or replace with good material before installation.

3.2 INSTALLATION

A. Mounting Heights:

1. Heights given are centerline heights up from finish floor unless noted otherwise; heights given "Number to Number" indicate that all shall be at one consistent height within limits given. Where heights of items are not listed, mount per recommendations of DHI.
 - a. Bottom hinge 10 to 13 inches
 - b. Top hinge 6 to 8 inches down from head
 - c. Intermediate hinges Equally spaced
 - d. Door knobs 36 to 40 5/16 inches
 - e. Door pull 42 to 48 inches
 - f. Deadlocks 54 inches floor to centerline

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- B. Fitting:
 - 1. Fit all hardware accurately and properly.
 - 2. Remove exposed parts until after painting is completed. Then reinstall.
 - 3. Securely fasten all fixed parts.
 - 4. Fit faces of mortised parts snug and flush.
 - 5. Ensure operating parts move freely and smoothly without binding, sticking, or excessive clearances.
- C. Adjusting and Finishing:
 - 1. After work has been otherwise completed, examine all hardware for complete and proper installation.
 - 2. Lubricate bearing surfaces of moving parts
 - 3. Adjust latching and holding devices to proper function
 - 4. Adjust door closer devices for proper speed and power.
 - 5. Test keys for conformance to approved Keying Chart system.
 - 6. Clean all exposed surfaces, check for surface damage and then polish.
- D. Thresholds:
 - 1. Install in one continuous piece, full width of opening. Set in full bed of sealant and fasten with countersunk anchors at 6 inches on center with Torx-head security screws with center reject pin.

3.3 DEFECTIVE WORK

- A. Where hardware is found defective in materials or installation; rework, restore, replace, or otherwise correct as directed.
- B. The following will be considered as defective materials:
 - 1. Unauthorized substitutions.
 - 2. Items delivered with missing, broken, damaged or defaced parts.
 - 3. Items of incorrect hand or function.
- C. The following will be considered as defective installation:
 - 1. Items broken, damaged, or defaced after delivery.
 - 2. Items incomplete, misaligned or incorrectly located.
- D. All expenses incurred by the Architect in troubleshooting the Security Hardware Work, caused by inadequate workmanship or other form of non-performance on the part of the subcontractor, shall be borne by that subcontractor.

END OF SECTION 111960

SECTION 114000 - FOOD SERVICE EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the contract including general and supplementary conditions and general requirements apply to the work specified in this section.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Plumbing: Refer to Division 22, including:
 - 1. Rough-in piping for gas and water supply and waste lines.
 - 2. Piping for supply and waste lines.
 - 3. Traps, grease traps, line strainers, tail pieces, valves, stops, shut offs and miscellaneous fittings required for complete installation.
 - 4. Final connections.
 - 5. Indirect drains for sink compartments.
 - 6. Disconnect existing equipment.
- B. Mechanical: Refer to Division 23, including:
 - 1. Roof mounted fans and connecting ductwork not shown as part of the kitchen equipment.
 - 2. Final connections, including approved welded duct connections to hoods.
 - 3. Disconnect existing equipment.
- C. Electrical: Refer to Division 26, including:
 - 1. Rough-in conduit, wiring, line and disconnect switches, safety cut-offs and fittings, control panels, fuses, boxes, and fittings required for complete installation.
 - 2. Final connections, including mounting and wiring of switches furnished as part of the food service equipment (unless otherwise indicated on the drawings).
 - 3. Disconnect existing equipment.
- D. Mechanical Work:
 - 1. Provide exhaust hoods with connection collars ready for final connection by HVAC Section.
 - 2. Provide stainless steel exposed ducts to ceiling for dishmachine.
- E. Existing Equipment:
 - 1. Contractor shall remove and store existing equipment at his expense in a controlled environment storage facility until such time as job site is ready for reinstallation.

2. Relocate those items of existing equipment noted as being reset to new positions shown on plan drawings. Coordinate resetting to minimize disruptions of operation of kitchen operations.
3. Remove remaining existing equipment from premises.
4. All piping, traps, etc. for reset equipment shall be new.

1.3 WORK INCLUDED THIS SECTION:

- A. Furnish and install all food service equipment as specified herein, including that which is reasonably inferred, with all related items necessary to complete work shown on contract drawings and/or required by these specifications.
- B. Electrical Work:
 1. Interwiring of food service equipment between components within equipment, such as heating elements, switches, thermostats, motors, etc., complete with junction box as is applicable, ready for final connection.
 2. Voltages shall be as indicated on contract drawings. Any differences in electrical characteristics at job site from those shown on contract documents must be submitted to Architect for consideration prior to ordering equipment.
- C. Plumbing Work:
 1. Furnish all equipment with faucets, sink waste assemblies, and trim as specified in this section.
 2. Other than sink compartments, extend all indirect waste lines to nearest floor receptor. All such drain lines to be properly sized. Drain shall terminate with proper air gap above flood rim of floor receptor. Drain lines to be copper with silver paint unless specified otherwise. Drain lines in public areas to be chrome plated where exposed to public view.
- D. Mechanical Work:
 1. Provide exhaust hoods with connection collars ready for final connection by Division 23.

1.4 QUALITY ASSURANCE

- A. It is required that all custom fabricated equipment such as food serving units, tables, sinks, counter tops, etc., be manufactured by a food service equipment fabricator who has the plant, personnel and engineering equipment required. Such manufacturer shall be subject to approval of Architect. All work in above category shall be manufactured by one manufacturer and shall be of uniform design and finish.
- B. Manufacturer of this equipment must be able to show that they are now and for the past five years have been engaged in manufacture or distribution of equipment, as required under this contract, as their principal product.
- C. Manufacturer of equipment herein specified shall be a recognized distributor for items of equipment specified herein which are of other manufacture than their own.

- D. Only manufacturers who can meet the foregoing qualifications will be acceptable.
- E. All work shall be done in an approved professional manner, to the complete satisfaction of the Owner.

1.5 SUBMITTALS

- A. Submit shop drawings as required by General Conditions. All shop drawings and rough-in drawings shall be CAD drafted and must be submitted in .DWF or .PDF electronic format. Multiple hard copies are not acceptable.
- B. Shop drawings and bound brochures covering manufactured or "buy-out" items covering all work and equipment included in this contract shall be submitted to Architect as soon as possible after award of contract. After approval, Food Service Equipment Contractor shall furnish to Architect electronic files of shop drawings and brochures, corrected as required by virtue of review comments, for distribution to various interested trades on project. All costs of reproduction and submission shall be part of contract.
Bound brochure and cut sheet submittals must be copied to Owner for review and comment.
- C. Provide fully dimensioned rough-in plans at 1/4" scale, consisting of a separate drawing for each discipline. Each drawing shall show equipment shaded down 50%. Rough-in set shall include all required mechanical, electrical, plumbing, services for equipment and dimensioned rough-in location for same. Rough-in locations shown shall make allowances for required traps, switches, etc., thereby not requiring interpretation or adjustment on the part of other Contractors. Food Service Equipment Contractor shall visit site to verify all rough-in and sleeve locations prior to installation of finished floors and shall cooperate with other Contractors involved in proper location of same. Food Service Equipment Contractor shall be responsible for any required relocations of rough-in due to errors or inaccuracies on those rough-in plans which they prepare.
- D. Rough-in plans shall include all required services which relate to equipment, but which may not directly connect thereto, such as convenience outlets at walls, hose stations, floor drains, etc.
- E. Rough-in plans shall also include all required outlet services for equipment which is designated on drawing schedule, even though such equipment may not be included in this contract. Drawings shall indicate dimensions for floor depressions, wall openings, etc., for equipment.
- F. Fully dimensioned and detailed shop drawings of custom fabricated equipment items shall be submitted, drawn at 3/4" and 1 - 1/2" scale for plans, elevations, and sections respectively. Drawings shall show all details of construction, installation, and relation to adjoining and related work where cutting or close fitting is required. Drawings shall show all reinforcements, anchorage, and other work required for complete installation of all fixtures.
- G. Do not begin fabrication of custom manufactured equipment until approvals of shop drawings have been received and until field measurements have been taken by Food Service Equipment Contractor, where such measurements are necessary to assure proper conformance with intent of contract drawings and specifications.

- H. Make field measurements, giving due consideration to any architectural, mechanical, or structural discrepancies which may occur during construction of building. No extra compensation will be allowed for any difference between actual measurements secured at job site and dimensions indicated on contract drawings. Any differences which may be found at job site during field measurements shall be submitted to Architect for consideration before proceeding with fabrication of equipment.
- I. Submit illustrative brochures for manufactured or "buy-out" equipment items, complete with illustrations, specifications, line drawings, rough-in requirements, and list of accessories or other specified additional requirements. Brochures shall be bound and shall include data on all equipment which is to be provided, arranged in numerical sequence which conforms to item numbers of specifications. Omission of data does not reduce obligation to provide items as specified.
- J. Approval of shop schedules and brochures will be in general and shall be understood to mean that Architect has no objection to use of materials or processes shown. Approval does not relieve Food Service Equipment Contractor from responsibility for errors, omissions, or deviations from their contract requirements.

1.6 SUBSTITUTIONS - STANDARDS

- A. Refer to Instructions to Bidders and Division 01 for requirements.
- B. All unspecified substitutions after bid must be submitted to Owner for written approval prior to acceptance.

1.7 DRAWINGS

- A. Drawings which constitute part of contract documents indicate general arrangement of piping and location of equipment. Should it be necessary to deviate from arrangement indicated to meet structural conditions, make such deviations without expense to Owner.
- B. Specifications and drawings are reasonably exact, but their extreme accuracy is not guaranteed. Drawings and specifications are for assistance and guidance of Contractor, and exact locations, distances and levels shall be governed by the building.

1.8 MANUFACTURER'S DIRECTIONS

- A. Follow manufacturer's directions in all cases where manufacturers of articles used in this contract furnish directions or prints covering points not shown on drawings or specifications.

1.9 INDUSTRY STANDARDS

- A. Electric operated and/or heated equipment, fabricated or otherwise, shall conform to latest standards of National Electric Manufacturers Association and of Underwriters Laboratories, Inc., and shall bear the U.L. label.

- B. Cooking and hot food holding equipment shall meet minimum construction standards as noted by NSF #4.
- C. Refrigeration equipment shall meet minimum construction standards as noted by NSF #7.
- D. Items of food service equipment furnished shall bear the N.S.F. seal.
- E. Food service equipment shall be installed in accord with N.S.F. standards.
- F. Work and materials shall comply with requirements of applicable codes, ordinances, and regulations, including but not limited to those of Occupational Safety and Health Act (OSHA), National Fire Protection Association, State Fire Marshal, State Accident Commission, U.S. Public Health Service, State Board of Health, local health codes, etc.
- G. No extra charge will be paid for furnishing items required by regulations, even though such may not be shown on drawings or called for in these specifications.
- H. Rulings and interpretations of enforcing agencies shall be considered part of regulations.

PART 2 - PRODUCTS

2.1 MANUFACTURED EQUIPMENT

- A. All like types of equipment such as all refrigerated and heated cabinets, all ovens, and all mixers shall be by the same manufacturer.
- B. Except as may be specified otherwise under individual item specifications in "Equipment Schedule", all items of standard manufactured equipment shall be complete in accord with manufacturer's standard specification for specific unit or model called for, including finishes, components, attachments, appurtenances, etc., except as follows:
 - 1. All items of standard equipment shall be that manufacturer's latest model at time of delivery.
 - 2. Substitutions for manufactured equipment specified will be accorded consideration under terms set forth in "Substitutions - Standards".

2.2 FABRICATED EQUIPMENT

- A. Stainless steel shall be U.S. standard gauges as called for, 18-8, Type 302, Type 304, No. 4 finish.
- B. Galvanized iron shall be Armco or equal. Framework of galvanized iron shall be welded construction, having welds smooth, and where galvanizing has been burned off, touched up with high grade aluminum bronze.
- C. Legs and crossrails shall be continuously welded, unless otherwise noted, and ground smooth.

- D. Bottom of legs at floor shall be fitted with sanitary stainless-steel bullet type foot, with not less than 2" adjustment.
- E. Legs shall be fastened to equipment as follows:
 - 1. To sinks by means of closed gussets. Gussets shall be stainless steel, reinforced with bushing, having set screws for securing legs.
 - 2. To tables and drainboards with closed gussets which shall be welded to stainless steel hat sections or channels, 14 gauge or heavier, exposed hat sections having closed ends. Bracing shall be welded to underside of tops.
- F. Closed gussets shall be a 3" minimum diameter at top, continuously welded to frame members or to sink bottom.
- G. Sinks, unless otherwise specified, shall be furnished with rotary type waste outlets, without connected overflows: Atlantic Brass Works Model 772-RB; Fisher Brass Foundry Model 250A; T&S; or approved equal. Where exposed, furnish wastes chromium plated.
- H. Rolls shall be 1 1/2" diameter, except as detailed contrary, with corners bullnosed, ground and polished.
- I. Seams and joints shall be shop welded. Welds to be ground smooth and polished to match original finish. Materials 18 gauge or heavier shall be welded.
- J. Metal tops shall be one-piece welded construction, unless specified otherwise, reinforced on underside with stainless steel hat sections or channels welded in place. Crossbracing to be not more than 30" on centers.
- K. Drawers to be 18-gauge stainless steel channel type housing and drawer cradle, both housing and cradle being reinforced and welded at corners, housing being secured to underside of table top, and both housing and cradle being sized for and fitted with 18-gauge 20" x 20" x 5" deep stainless-steel drawer insert having coved corners. Drawer insert shall be easily removable from cradle without tools or having to remove entire drawer. Drawers to have stainless steel fronts. Provide with recessed flush type stainless steel pulls.
- L. Support drawer on fabricated 14-gauge stainless steel interlocking channel solid delrin ball bearing wheels. Support slides shall be load rated at 200 lb. per pair. Slides to be Component Hardware S52 Series.
- M. Enclosed cabinet type bases shall be made of formed steel sheets reinforced with formed steel sections to create a rigid structure. Steel shall be 18-gauge or heavier. Base shall be welded construction throughout with front rails, mullions, etc., welded to appear as one-piece construction. All exposed sections of interior and exterior shall be stainless steel, and unexposed sections shall be galvanized steel, unless specified contrary.
- N. Hardware shall be solid materials and except where unexposed or specified contrary, of cast brass, chrome plated. Stampings are not acceptable. Identify all hardware with manufacturer's name and number so that broken or worn parts may be ordered and replaced.

- O. Fabricate sink compartments with fully coved vertical and horizontal corners. Multiple compartment partition to be double thickness, continuously welded where sheets join at top. Front of multiple compartment sinks to be continuous on exterior. Bottoms shall be creased to drain.
- P. Ends of all fixtures, splashbacks, shelves, etc., shall be finished flush to walls or adjoining fixtures.
- Q. Fabricate sink compartments with fully coved vertical and horizontal corners. Multiple compartment partition to be double thickness, continuously welded where sheets join at top. Front of multiple compartment sinks to be continuous on exterior. Bottoms shall be creased to drain.
- R. Ends of all fixtures, splashbacks, shelves, etc., shall be finished flush to walls or adjoining fixtures.
- S. Dishtables, draintables, splashbacks and turned-up edges shall have radius bends in all horizontal and vertical corners, coved at intersections.
- T. Rounded and coved corners or radius bends shall be 1/2" radius or longer.
- U. Shelves in fixtures with enclosed bases shall be turned up on back and sides and feathered slightly to insure tight fit to enclosure panels. Bottom shelves shall be made for easy removal unless otherwise noted.
- V. Undersides of tops to be coated with heavy-bodied resinous material compounded for permanent, non-flaking adhesion to metal, 1/8" thick, applied after reinforcing members have been installed, drying without dirt-catching crevices.
- W. Metal components, unless specified or noted otherwise, to be the following gauges:

Counter and table tops	14 ga.	Stainless Steel
Wall shelves	16 ga.	Stainless Steel
Pipe leg undershelves	16 ga.	Stainless Steel
Drawer fronts	16 ga.	Stainless Steel
Enclosed cabinet bases	18 ga.	Stainless Steel
Sinks and drainboards	14 ga.	Stainless Steel
Exhaust hoods	18 ga.	Stainless Steel
Legs 1 - 5/8" diameter	16 ga.	Stainless Steel
Doors (outer pan)	18 ga.	Stainless Steel
Doors (inner pan)	20 ga.	Stainless Steel
- X. Products fabricated by Savannah Industrial Solutions, John Boos, Premier Stainless, Eagle Group, Advance Tabco, or approved equal, modified to comply with specifications, are acceptable.

2.3 HEATING EQUIPMENT

- A. Wherever electric heating equipment or thermostat control for such equipment is specified, it shall be complete, and of the materials, size and rating specified within equipment item or details. All such equipment shall be designed and installed to be easily cleaned or to be easily removed for cleaning.

- B. Electrical appliances or heating element circuits of 120 volts shall not exceed 1650 watts, unless specifically shown contrary.

2.4 SWITCHES AND CONTROLS

- A. Food Service Equipment Contractor shall supply on each motor driven appliance or electrical heating unit suitable control switch of proper type in accord with Underwriter's Code.
- B. All internal wiring for fabricated equipment items included, all electrical devices, wiring, controls, switches, etc., built into or forming an integral part of these items shall be furnished and installed by Food Service Equipment Contractor in their factory or building site with all items complete to junction box for final connection to building lines by Electrical Contractor.
- C. Provide standard 3-prong plugs to fit "U" slot grounding type receptacles, similar to No. 5262, for all equipment items powered by plugging into 110-120 volts, single phase AC. Also, provide suitable length 3-wire cord for equipment.

2.5 CONNECTION TERMINALS

- A. All equipment shall be complete with connection terminals as standardized by equipment manufacturers, except where specified otherwise.

2.6 LOCKS

- A. Fit all doors for reach-in refrigerated compartments with locking type latches. Provide master keys.

PART 3 - EXECUTION

3.1 GENERAL

- A. Work under this contract and covered under this section of specifications includes but is not limited to:
 - 1. Cutting of holes and/or ferrules on equipment for piping, drains, electrical outlets, conduits, etc. as required to coordinate installation of food service equipment with work of other Contractors on project.
 - 2. Field checking of building and rough-in requirements, and submission of brochures and shop drawings, all as required hereinbefore under "Submittals".
 - 3. Repair of all damage to premises as result of this installation, and removal of all debris left by those engaged in this installation.
 - 4. Having all food service equipment fixtures completely cleaned and ready for operation when building is turned over to Owner.

3.2 INSTALLATION PROCEDURES

- A. Food Service Equipment Contractor shall make arrangements for receiving their custom fabricated and "buy out" equipment and shall make delivery into building as requisitioned by their installation superintendent. They shall not consign any of their equipment to Owner or to any other Contractor unless they have written acceptance from them and have made satisfactory arrangements for the payment of all freight and handling charges.
- B. Food Service Equipment Contractor shall deliver all their custom fabricated and "buy out" equipment temporarily in its final location, permitting Trades to make necessary arrangements for connection of service lines; they shall then move equipment sufficiently to permit installation of service lines, after which they shall realign their equipment level and plumb, making final erection as shown on contract drawings.
- C. All portable or counter mounted equipment weighing more than 25 pounds shall be mounted on 4" stainless steel adjustable legs.
- D. This Contractor shall coordinate their work and cooperate with other trades working at site toward the orderly progress of the project.
- E. Architect or Owner's Agent shall always have access to plant or shop in which custom fabricated equipment is being manufactured, from time contract is let until equipment is shipped, in order that progress of work can be checked, as well as any technical problem which may arise in coordination of equipment with building. Any approval given at this point of manufacture shall be tentative, subject to final inspection and test after complete installation.
- F. Food Service Equipment Contractor shall assist Architect, Owner, and/or Owner's Agent in making any desired tests during or prior to final inspection of equipment; they shall remove immediately any work or equipment rejected by Architect, Owner, and/or Owner's Agent, replacing same with work conforming with contract requirements, and shall reimburse mechanical and/or other contractors involved for extra work made necessary by such replacement.
- G. This Contractor shall keep premises free from accumulation of their waste material and rubbish, and at completion of their work shall remove their rubbish and implements, leaving areas of their work broom clean.
- H. This Contractor shall provide and maintain coverings or other approved protection for finished surfaces and other parts of their equipment subject to damage during and after erection. After removal of protective coverings, all field joints shall be grounded, polished and entire work shall be thoroughly cleaned and polished.

3.3 TRIMMING AND SEALING EQUIPMENT

- A. Seal completely spaces between all units to walls, ceilings, floors, and adjoining (not portable) units with enclosed bodies against entrance of food particles or vermin by means of trim strips, welding, soldering, or commercial joint material best suited to nature of equipment and adjoining surface material.
- B. Close ends of all hollow sections.

- C. Equipment butting against walls, ceilings, floor surfaces and corners to fit tightly against same; backsplashes or risers which fit against wall to be neatly scribed and sealed to wall with Dow Corning # 732 RTV or General Electric clear silicone sealant, wiping excess sealant out of joint to fillet radius. Where required to prevent shifting of equipment and breaking wall seal, anchor item to floor or wall.
- D. Treat enclosed spaces (inaccessible after equipment installation) for vermin prevention in accord with industry practice.

3.4 TESTING AND DEMONSTRATION OF EQUIPMENT

- A. After completion of installation, all equipment using water, gas, and electricity shall be performance inspected and tested by factory certified service agent, including wet test of hood fire suppression systems, if so required. Food Service Equipment Contractor shall document that these inspections have been performed prior to scheduling demonstrations and Owner acceptance of equipment.
- B. Food Service Equipment Contractor shall arrange to have all manufactured, mechanically operated equipment furnished under this contract demonstrated by authorized representatives of equipment manufacturers, these representatives to instruct Owner's designated personnel in use, care and maintenance of all items of equipment after same are in working order. Demonstration and instruction shall be held on dates designated by Owner.
- C. Food Service Equipment Contractor shall provide a competent service representative to be present when installation is put into operation.

3.5 EQUIPMENT HANDLING AND STORAGE

- A. Deliver equipment to site, properly crated and protected, and store in safe place, protected from damage until time for installation.

3.6 GUARANTEE

- A. Special Project Warranty: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, with inadequate and defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required, provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. This warranty shall be in addition to, and not limitation of, the rights the Owner may have against the Contractor under the Contract Documents.
- B. Warranty Period:
 - 1 year minimum from date of Substantial Completion, all new equipment furnished.
 - 5-year warranty period on refrigeration compressors.
 - 10-year warranty period on walk-in panels.

3.7 OPERATING AND MAINTENANCE MANUALS

- A. After completion of installation, Food Service Equipment Contractor shall present to Owner three sets of all operating and maintenance manuals, covering all mechanically operated equipment furnished under this contract, each set being neatly bound in loose-leaf binder having durable cover.
- B. Include in each binder a list of names, addresses and telephone numbers of local servicing agencies authorized to make necessary repairs and/or adjustments of equipment furnished under this contract.

PART 4 – EQUIPMENT SCHEDULE

ITEM 01	COLD STORAGE ASSEMBLY	QUANTITY AS SCHEDULED

Provide pre-fabricated cold storage room assembly of size and shape shown on plan and detail drawings. Exact overall size to be field verified prior to fabrication.

- A. Insulation:
Panels shall be insulated with 4” thick urethane, foamed or poured in place using HCPC (no CFC) blowing agent. Foam shall be 2.25 lb. density, 95% closed cell. Panels shall meet STME-84 (UL-723) and be listed by Underwriters laboratories. Panels shall have a maximum flame spread of 25, and a maximum smoke developed of 450 minimum. Flash ignition of 600 degrees and minimum self-ignition of 800 degrees F.
- B. Coved corners:
Assembly shall be constructed so that all interior wall, floor and ceiling intersections shall comply with N.S.F. requirements.
- C. Cam lock fasteners:
All panel intersections and wall, floor and ceiling intersections shall be secured by camlock fasteners connected with 2” wide metal straps set in and surrounded by insulation.
- D. Finishes:
Exterior and interior finishes shall be as shown on drawings.
- E. Doors:
Door size and finish shall be as shown on drawings, and shall be furnished complete with sill wiper gasket, and a minimum of 3 spring loaded lift type hinges. Doors to be Super doors with a reinforced 14 ga. U-Channel steel frame, backed with additional 1/8” steel plate drilled and tapped where all hardware is mounted. 3/16” backing on all doors larger than 42” wide.
Exterior door to be equipped with automatic door closer.
Cooler and Freezer doors to be equipped with perimeter heat.
All doors to be equipped with heavy duty padlocking pull-handle lever, with inside safety release.
- F. Thermometers:
Each compartment to be provided with exterior flush mounted thermometer mounted at eye level to each door. Provide remote read-out for freezer compartment at exterior cooler door.
- G. Lights:
Each compartment to be furnished complete with manufacturer's standard light fixtures, having protective cover, mounted and pre-wired to switch with pilot light in door section. Extra light fixtures as needed to provide 30-foot candles 30" above floor. Lights to be furnished and installed by this section.

- H. Ceiling panels to be one piece, self-supporting and span full width of assembly when available.
- I. Floor:
Recessed floor by Food Service Equipment Contractor with .100 diamond tread.
Reinforced floor panels to support minimum 1200 pounds per square foot.
The floor and ceiling shall have maximum length panels to span full length of box, if possible, otherwise stagger joints so there are no common "four corner" intersections and no joints occurring in doorways.
- J. Refrigeration System:
Shall be furnished by manufacturer as part of cold storage room assembly, provide each compartment with complete refrigeration system sized to maintain appropriate temperature. Provide temperature alarm system with remote read-out and recording capability. Condensing units to be air-cooled, remote. Units to have performance and wiring characteristics as scheduled on drawings. Refrigeration systems to be designed for use with R448 refrigerant. Condensing units to be provided with painted galvanized steel all-weather housing, controls, and crankcase heaters, all suitable for outdoor conditions, and located as shown on drawings. Evaporators to be low-silhouette type with adaptive defrost control equal to a Bally SmartVap+controller. Evaporators to be equipped with 2speed EC motors, running full speed while refrigeration is engaged, and running at 1/3 speed while system is pumped down; mounted at locations shown on drawings. Performance and wiring characteristics to be as scheduled on drawings. Condensing units shall be provided with 2 speed EC fan motors, running full speed while refrigeration is engaged and 1/2" speed while ambient temp is below 60 degrees Fahrenheit. Also, the crank case heater will be turned off at an ambience above 60 degrees Fahrenheit.
Evaporator drain lines to be provided by this section and extended to floor receptors outside assembly.
Freezer drain lines to be wrapped with heater cable and insulated with pre-molded foamed plastic insulation suitable for the application. Thickness as recommended by manufacturer.
Refrigerant piping to be ACR copper tubing, hard temper, with wrought fittings and silver solder joints. Insulate suction lines with pre-molded foamed plastic insulation, thickness as recommended by manufacturer for temperature and application.
Refrigeration systems to be provided with all required refrigerant piping, insulation, sight glass vibration eliminator, solenoid(s), dryer, suction line filter, expansion valve(s), thermostat(s), heat exchangers, and defrost timers, etc. as necessary for complete installation. Provide pump down control circuit consisting of thermostat and solenoid valve. All components including piping and insulation to be installed using accepted industry standards, manufacturer's instructions and first-class workmanship.
- K. Miscellaneous:
Assembly to be installed on depressed building slab. See detail drawing.
Provide 1/8" diamond tread wainscot along exposed front exterior of assembly mounted from floor to 48" A.F.F.
Provide trim strips, closure panels, etc., as necessary to trim assembly to adjacent building surfaces.
Provide removable top closure panels with "C" channel rails. Lift-out panel sections to have turn-down edges for strength and are not to exceed 4'-0" in length.
Provide plastic strip curtains at door locations, transparent vinyl overlapping strips, aluminum bar hanging rod and bracket, suitable for low temperature application, as manufactured by Curtron, Flexstrip Products, Inc., or equal. Size to suit openings.
Provide heated pressure relief port in freezer.
Provide sleeves properly located for utility entrance, drain lines, and refrigeration lines, and after lines are installed, fill sleeves with spray foam compound, suitable for use in refrigerated spaces. Trim excess foam away and cover with stainless steel escutcheon. Cold storage room

shall be erected by factory trained, or factory approved installers or shall be supervised by factory personnel. Refrigeration systems shall be furnished by cold storage room manufacturer and installed by factory approved personnel. Shop drawing submittal shall indicate who the installer is, and a letter of approval shall accompany the submittal indicating the manufacturer's acceptance of the installers.

This specification does not constitute a complete description of cold storage assembly, also see plan and detail drawings.

Cold storage room assembly to be as manufactured by Bally, Arctic, Norlake, American Panel, Imperial/Brown, or Masterbilt complying with specifications and drawings.

This item is to be reset from Owner's existing facility by Food Service Equipment Contractor.

Provide pre-rinse unit for Item 02 with the following features:

- Pre-rinse assembly to be as manufactured by T&S Brass, Model No. 313296.

This item is to be reset from Owner's existing facility by Food Service Equipment Contractor.

This item is to be reset from Owner's existing facility by Food Service Equipment Contractor.

This item is to be reset from Owner's existing facility by Food Service Equipment Contractor.

This item is to be reset from Owner's existing facility by Food Service Equipment Contractor.

This item is to be reset from Owner's existing facility by Food Service Equipment Contractor.

Provide commercial waste container with the following features:

- ## FOOD SERVICE EQUIPMENT

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- D. 14/304 Stainless steel top
- E. 8"H Backsplash
- F. Raised rolled edges on front & side
- G. Stainless steel legs & crossbracing
- H. Adjustable metal feet
- I. Dishtable galvanized undershelf, 36"W x 24"D
- J. Table limit switch provisions

Dishtable to be as manufactured by Eagle Group, Model CDTR-84-14/3, Titan Stainless, or John Boos.

ITEM 18 HAND SINK

QUANTITY AS SCHEDULED

Provide hand sink with the following features:

- A. Wall mount
- B. Nom. 13" Wide x 10" front-to-back x 7" deep bowl
- C. 304 Stainless steel construction
- D. Splash mount gooseneck faucet
- E. Basket drain
- F. Deck mounted soap dispenser
- G. Seamless design-positive drain
- H. Inverted "V" edge

Hand sink to be as manufactured by Eagle Group, Model HSA-10-F-DS, Titan Stainless, or John Boos.

ITEM 19 UNIVERSAL PAN RACK

QUANTITY AS SCHEDULED

Provide mobile pan rack with the following features:

- A. Open frame design
- B. Square cube construction
- C. (20) Universal slides, 3" centers
- D. All-welded aluminum construction
- E. End loading
- F. Slides for 12" x 20", 18" x 26" & 13" x 18" pans
- G. 3-1/4" Wide runners
- H. (4) 5" Platform casters

Universal pan rack to be as manufactured by New Age, Model No. 1306, Titan Stainless, or Eagle Group.

ITEMS 20

NOT USED

ITEM 21 COMBI OVEN, ELECTRIC

QUANTITY AS SCHEDULED

Provide 10-full size combi oven with the following features:

- A. (10) 18" x 26" Sheet pan or (20) 12" x 20" steam pan or (10) 2/1 GN pan capacity
- B. (5) Stainless steel grids included
- C. Digital color display screen with push button control
- D. (3) Manual operating modes: steam, convection & combination
- E. 85° To 572°F temperature range
- F. (100) Program slots
- G. Core temperature probe
- H. Retractable hand shower
- I. 5-Speed fan
- J. Automatic cleaning programs, integrated care system

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WAKE COUNTY, NORTH CAROLINA
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- K. Water filtration system
- L. Backflow preventer
- M. Stationary Oven Stand, 27-1/2"H
- N. Voltage as scheduled, direct connection

Electric combi oven to be as manufactured by RATIONAL, Model No. ICC 10-FULL E, Alto Shaam, or Blodgett.

ITEM 21.1 VENTLESS CONDENSATION HOOD QUANTITY AS SCHEDULED

Provide ventless recirculating condensation hood for Item 20 with the following features:

- A. With HEPA filter for smoke capture
- B. Filters smoke
- C. For single or Combi-Duo
- D. Voltage as scheduled, cord and plug

Condensation hood to be as manufactured by RATIONAL, Model No. 60.76.178, Alto Shaam, or Blodgett.

ITEM 22 MOBILE HEATED CABINET QUANTITY AS SCHEDULED

Provide mobile heated cabinet having the following features:

- A. Mobile
- B. Full height
- C. Insulated
- D. Clear polycarbonate door, removable bottom mount control module
- E. Thermostat to 200°F
- F. Fixed wire slides on 3" centers (18) 18" x 26" or (34) 12" x 20" x 2-1/2" pan capacity
- G. 5" Casters
- H. Aluminum construction
- I. Voltage as scheduled, cord and plug

Mobile heated cabinet to be as manufactured by Metro, Model C539-HFC-4, Winston, or Cres-Cor.

ITEM23 REACH-IN DUAL TEMP CABINET QUANTITY AS SCHEDULED

Provide mobile heated cabinet having the following features:

- A. Dual-temp
- B. Reach-in, two-section
- C. 21.01 cu. ft (refrigerator, left) & 21.01 cu. ft. (freezer, right)
- D. (1) Right solid hinged door, (1) Left solid hinged door
- E. (10) Adjustable shelves
- F. Electronic control
- G. LED interior lighting
- H. Digital display
- I. Stainless steel interior & exterior
- J. Bottom-mounted self-contained refrigeration
- K. R-290 Hydrocarbon refrigerant
- L. 6" Heavy duty casters, (2) locking
- M. Voltage as scheduled, (2) cord and plug

Mobile heated cabinet to be as manufactured by Beverage Air, Model No. HBRF49HC-1-A, True, or Victory.

ITEM 24 SHELVING UNIT, WIRE QUANTITY AS SCHEDULED

Provide mobile shelving unit with the following features:

- A. 48"W x 21"D x 63"H
- B. 600 - 800 Lb. capacity
- C. Includes (4) wire shelves & (4) posts
- D. Gray epoxy antimicrobial finish
- E. 5" Casters

Wire shelving unit to be as manufactured by Quantum, Model No. WR63-248GY, Eagle Group, or Metro.

ITEM 25 ICE MAKER, CUBE-STYLE

QUANTITY AS SCHEDULED

Provide ice maker with the following features:

- A. Cube style
- B. Air-cooled
- C. Self-contained condenser
- D. Production capacity up to 640 lb./24 hours at 70°/50°
- E. Small cube size
- F. Mobile app, Bluetooth® connectivity, unit specific QR code
- G. Preservation mode
- H. External bin full indicator
- I. Alert indicating lights
- J. Adjustable purge control
- K. One-touch cleaning
- L. Front facing removable air filter
- M. Stainless steel finish
- N. Antimicrobial protection
- O. Water filtration system
- P. Backflow preventer
- Q. B-530 Ice bin, 536 lb. capacity, 30"W, 6" legs
- R. Voltage as scheduled, direct connection

Ice machine to be as manufactured by Scotsman, Model No. MC0630SA-32, Hoshizaki, or Ice-O-Matic.

ITEM 26 SERVING COUNTER, COLD FOOD

QUANTITY AS SCHEDULED

Provide cold food counter module having the following features:

- A. Refrigerated cold pan unit, electric
- B. 37"W x 26"D x 34-1/2"H
- C. Open base
- D. (2) 12" x 20" openings (20" front to back)
- E. Stainless steel construction
- F. Vertical corner bumpers
- G. 4" heavy duty swivel casters (2 with brakes)
- H. Self-contained refrigeration
- I. Voltage as scheduled, cord and plug

Cold food serving counter to be by Caddy, Model RIF-602, Duke, or Delfield.

ITEM 27 HOT FOOD SERVING COUNTER

QUANTITY AS SCHEDULED

Provide hot food counter module having the following features:

- A. Hot Food Caddy, electric, open base
 - B. 82"W x 26"D x 34"H
 - C. (5) 12"x20" Hot food wells
 - D. Stainless steel construction
 - E. Vertical corner bumpers
 - F. Insulated wells with individual heat controls
 - G. Tilted control panel
 - H. 4" heavy duty swivel casters (2 with brakes)
 - I. Voltage as scheduled, cord and plug
- Counter to be as manufactured by Caddy, Model TF-605, Duke, or Delfield.

ITEM 28	WORK TABLE, 120X24	QUANTITY AS SCHEDULED

Provide work table with the following features:

- A. 120"W x 24"D
- B. 14/300 Series stainless steel top
- C. Rolled edge on front & back
- D. Adjustable 18/300 series stainless steel undershelf with marine edge
- E. Locking gusset system
- F. (6) Stainless steel legs & adjustable bullet feet

Work table to be as manufactured by Eagle Group, Model No. T24120SE, Titan Stainless, or John Boos.

ITEM 29	BUSSING UTILITY CART	QUANTITY AS SCHEDULED

Provide mobile utility cart with the following features:

- A. Open base
- B. Nom. 38"W x 22"D x 35"H
- C. (3) Shelves with notched corners
- D. Shelf size approximately 36" x 24", 8-1/4" shelf clearance
- E. (2) U-shaped handles
- F. Stainless steel construction
- G. 4" Polyurethane swivel casters

Bussing utility cart to be as manufactured by Caddy, Model No. T-203-B, Lakeside, or New Age.

ITEM 30 NOT USED

ITEM 31 NOT USED

ITEM 32	COMMERCIAL WASHER, 55 LB.	QUANTITY AS SCHEDULED

Provide 55-60 lb. capacity soft-mount Washer-Extractor with the following features:

- A. Programmable controls
- B. Slanted accessible control panel
- C. Stainless steel front, top and side panels
- D. Stainless steel inner drum and tub
- E. Large drain valve
- F. High-capacity water inlets
- G. Four (4) compartment dispenser
- H. Eight (8) liquid chemical connections
- I. Thirteen (13) chemical ports of various sizes including 1/2" manifold flush connections

- J. Clear door window
K. Ozone-compatible design
L. Durable drive belt
M. Voltage as scheduled, direction connection
Washer-Extractor to be as manufactured by Unimac, Model UY55, Speed Queen, or Continental.

ITEM 33	COMMERCIAL DRYER, 75 LB.	QUANTITY AS SCHEDULED

Provide fast drying 75-80 lb. capacity dryer with the following features:

Dryer to be as manufactured by Unimac, Model UTF-75N, Speed Queen, or Continental.

ITEM 34	ONE (1) COMPARTMENT SINK	QUANTITY AS SCHEDULED

Provide utility sink with the following features:

Utility sink to be as manufactured by Eagle Group, Model No. 2124-1-16/4, Titan Stainless, or John Boos.

END OF SECTION 114000

**SECTION 125000
DETENTION CONSOLES**

PART 1 GENERAL

1.01 DEFINITIONS

- A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation, indicated in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specific manufacturer's product that is named and accompanied by the words "basis of design" or "design standard," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.
- C. Manufacturer's Warranty Lifetime: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
- D. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

1.02 SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced.
 - 1. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 - b. Coordination information, including a list of changes or modifications to other parts of the Work and to construction performed by Owner and separate Vendors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.

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- e. Samples, where applicable or requested.
 - f. The same warranty for the substitution as required for the specified product.
 - g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - h. Vendor's certification that cost data presented is complete and includes all related costs under this Contract except the Architect's redesign costs, if any, and a waiver of all claims for additional costs related to the substitution which subsequently becomes apparent.
 - i. Vendor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
 - j. Vendor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
2. Vendor shall coordinate the installation of an accepted substitute with other Work, making such changes as may be required for the Work to be complete in all aspects.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation promptly upon receipt of a request for substitution. Architect will notify Vendor, in writing, of acceptance or rejection of proposed substitution.

1.03 QUALITY ASSURANCE

- A. Product Qualifications: Products and manufacturers named establish requirements for product quality in terms of appearance, construction and performance.
- B. All materials used for the manufacture or construction of any supplies, materials, or equipment shall be new. Unless otherwise specified, products must be new, the latest model, the best quality, and the highest grade workmanship.
- C. Installer Qualifications: An experienced installer whose installed work has resulted in a record of successful installations in accordance with manufacturer's requirements.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products and materials using means, methods, techniques, and sequences that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions. Failure to comply with these requirements will result in withholding a portion of payment until deficiencies in means, methods, techniques, and sequences are corrected and proof is provided that products and materials were not damaged, at which time withheld sum will be released.
 - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 - 4. Inspect products upon delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
 - 5. Store products to allow for inspection and measurement of quantity or counting of units.
 - 6. Store and handle materials in a manner that will not endanger or damage Project structure.

7. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
8. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
9. Protect stored products from damage.

PART 2 PRODUCTS

2.01 PRODUCT OPTIONS

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged, and unless otherwise indicated, that are new at time of installation.
 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 4. Where products are accompanied by the term "match sample," match the Architect's sample.
 5. Descriptive, performance, and reference standard requirements in the Contract Documents establish the "salient characteristics" of products.
- B. Product Selection Procedures: Procedures for product selection include the following:
 1. Product: Where Specifications name a single product and manufacturer, provide the product named. Substitutions will be considered, unless otherwise indicated.
 2. Manufacturer/Source: Where Specifications name single manufacturers or sources, provide a product by the manufacturer or from the source named that complies with requirements. Substitutions will be considered, unless otherwise indicated.
 3. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Substitutions will not be considered, unless otherwise indicated.
 4. Available Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed or another product that complies with requirements. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
 5. Available Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed or another manufacturer that complies with requirements. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
 6. Basis-of-Design Products: Where Specifications indicate "Basis-of-Design Product" or "Design Standard" and also include or refer to a limited list of manufacturers' names ("Manufacturers"), provide either the specified product or a comparable product by one of the other named manufacturers. Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. If list of manufacturers is not limited ("Available Manufacturers") comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
 7. Visual Matching Specification: Where Specifications require matching an established sample, select a product (and manufacturer) that complies with requirements and matches

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Architect's sample. Architect's decision will be final on whether a proposed product matches satisfactorily.

- a. If no product available within specified category matches satisfactorily and complies with other specified requirements, comply with provisions of the Contract Documents on "substitutions" for selection of a matching product.

2.02 SCHEDULE OF PRODUCTS

- A. Subject to compliance with requirements, provide furnishings indicated on the Schedule of Products tables below.
 1. Provide the 'Basis of Design' product or an approved equivalent.
 2. All items within a Manufacturer lot must be obtained from a single vendor source.
 3. All finishes shall be selected from manufacturer's full range of colors and textures.
 4. COM fabrics (fabrics supplied by a fabric manufacturer and not the specified furniture manufacturer) shall be included with the corresponding manufacturer of product specified to utilize the COM fabric.
 5. When providing products other than the "Basis of Design" manufacturer(s) specified, all items within a manufacturer's lot shall be from one manufacturer.
 6. All storage components shall have locks. Key all work stations alike with a unique key number. Key all banks of file with random unique lock numbers.
- B. Schedule of Products.
 1. Provide the Basis-of-Design product from Watson Consoles Mercury Collection or a comparable product by one of the following:
 - a. Russ Bassett.
 - b. Eaton.
 2. Provide the 'Basis of Design' product from Watson or an approved equal. - verify layout with end user.
 - a. Adjustable Height Worksurafe 72x36 w/ steel lifting columns
 - b. Slat-Rail Monitor System - 6 monitor with the ability to increase to 12, adjustable
 - c. Tackable Privacy Screens 3 sides; 22"h
 - d. Technology Cabinet with axial fans & stackable storage cabinet
 - e. Technology Bridge
 - f. Hub Cabinet - for dedicated power and data entry points and cable management
 - g. User accessible plug-ins: 4

PART 3 EXECUTION

3.01 EXAMINATION

- A. Prior to shipment, delivery and installation inspect the project premises to confirm physical and environmental conditions under which the work to be performed is acceptable to receive furniture.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Inspect furniture prior to installation. Repair or replace any items that have been damages or are not in compliance with contract documents.

3.02 INSTALLATION

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- A. Furnish all labor, materials, furniture, furnishings and equipment, tools installation equipment and machinery, delivery and other facilities and services necessary for proper execution and completion of the Work.
- B. Delivery and installation of all furniture, furnishings and equipment shall be made to the locations specified in the contract documents.
- C. Installation of furniture, furnishings and equipment shall include testing as required by the contract documents.
 - 1. Verify that all components and devices are operating properly.
 - 2. Verify that all doors and drawers are flush, level and plumb.
 - 3. Freestanding storage units shall be leveled.
 - 4. Wipe down furniture with manufacturer approved material, so that furniture is free of dust, dirt, including any foreign particles and ready for use.
 - 5. Replace any product damaged during installation.
 - 6. Keys to lockable furniture items shall be placed in lock plugs, unless otherwise directed by owner.

3.03 ACCEPTANCE OF MATERIAL

- A. The furniture delivered shall remain the property of the contractor until a physical inspection is made by the Architect, and thereafter accepted by and to the satisfaction of the Owner. In the event the goods supplied (or Work provided) to the Owner are found to be defective or do not conform to Contract Documents (including the Specifications), the Owner reserves the right to cancel the order upon notice (verbal or in writing) to the Contractor and return goods to the Contractor at the Contractor's expense.

3.04 PROTECTION

- A. After completing the furniture installation, provide protection for furniture from possible damage by other trades. Maintain protection until construction traffic has ended and Project is Substantially Complete.

END OF SECTION 125000

SECTION 210500 - COMMON WORK RESULTS FOR FIRE-SUPPRESSION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 QUALITY ASSURANCE

- A. Equipment and appliances comprising portions of the mechanical systems regulated by the International Mechanical Code shall be listed and labeled in accordance with the current edition of the North Carolina Building Code.
- B. Equipment and appliances comprising portions of the fire suppression systems regulated by the NFPA 13 shall be installed in accordance with the listing and the manufacturer's installation instructions. Manufacturer's installation instructions shall be available on the job site for use and inspection.
- C. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- D. 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 Fire-suppression piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- E. Electrical Characteristics for Fire-Suppression Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

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1.4 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for fire-suppression items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

1.5 INTENT OF CONTRACT DOCUMENTS

- A. Fire Suppression/Protection drawings are diagrammatic, indicating general locations and arrangements of pipe, and equipment. Not necessarily indicating all offsets, conditions, and appurtenances required to provide clearances for maximum practical accessibility to perform maintenance.
- B. Coordinate work to achieve proper operation and to provide a maintainable installed condition.
- C. Notify the Architect's representative immediately of conditions which do not comply or will not produce this result.

PART 2 - PRODUCTS

2.1 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match fire-suppression piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180°F.
- D. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and non-corrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225°F.
- F. Dielectric Nipples: Electroplated steel nipple with inert and non-corrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225°F.]

2.2 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 3. Pressure Plates: Plastic. Include two for each sealing element.
 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 JOINING MATERIALS

- A. Pipe Joint Compound for Threaded Pipe: UL listed.

2.4 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.5 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around fire-suppression 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. Finish: Polished chrome-plated and rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw. Finish: Polished chrome-plated and rough brass.

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- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With exposed-rivet hinge, set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

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, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 FIRE-SUPPRESSION PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install fire-suppression piping according to the following requirements and Division 21 Sections specifying fire-suppression piping systems.
- B. Install fire-suppression piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- C. Install fire-suppression piping indicated to be exposed and fire-suppression piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise. Diagonal runs are permitted in the attic spaces.
- D. Install fire-suppression piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install fire-suppression piping to permit valve servicing.
- F. Install fire-suppression piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Select system components with pressure rating equal to or greater than system operating pressure.
- I. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. Fire-suppression piping:

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- a. Fire-suppression piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Fire-suppression piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Fire-suppression piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Fire-suppression piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Fire-suppression piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - f. Bare Fire-suppression piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
 - g. Bare Fire-suppression piping in Equipment Rooms: One-piece, cast-brass type.
 - h. Bare Fire-suppression piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- J. Sleeves are not required for core-drilled holes through solid concrete walls and floors.
- K. Sleeves are required in all interior partitions.
- L. Permanent sleeves are not required for holes formed by removable PE sleeves.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
 - 3. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

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1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- P. 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.
- Q. Verify final equipment locations for roughing-in.
- R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- 3.2 FIRE-SUPPRESSION PIPING JOINT CONSTRUCTION
- A. Join pipe and fittings according to the following requirements and Division 21 Sections specifying fire-suppression 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. 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 pipe joint 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.
- E. Grooved Joints: Assemble joints with listed coupling, gasket, lubricant, and bolts.
1. Ductile-Iron Pipe: Radius-cut-groove ends of piping. Use grooved-end fittings and grooved-end-pipe couplings.

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- 2. Steel Pipe: Roll-groove piping. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.
- 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 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 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 centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.4 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.

3.5 GROUTING

- A. Mix and install grout for fire suppression 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.

3.6 EXCAVATION AND BACKFILL

- A. Excavation and backfill shall be as indicated in Division 1 specifications and on the drawings. If excavation and backfill is not otherwise indicated the following shall apply:
 - 1. Excavate trenches to indicated gradients, lines, depths, and elevations.
 - a. Beyond the building perimeter, excavate trenches to allow installation of top of pipe below minimum depth of cover based on locality or 1'-0" below frost line whichever is lower.
 - 2. Excavate trenches to uniform widths to provide twelve inches clear on each side of pipe. Excavate trench walls vertically from trench bottom.
 - 3. Trench Bottoms: Excavate trench bottoms to provide flat surface. Place and compact six inches of sand. Excavate and shape sand to provide uniform bearing and support of pipes. Shape sand to provide continuous support for bells, joints, fittings, and barrels of pipes. Sand shall be free of projecting stones and sharp objects.
 - 4. Backfill and hand tamp to 95% proctor to six inches above the top of the pipe.
 - 5. Backfill and machine tamp the remainder of the trench to 95% proctor in twelve-inch lifts.

END OF SECTION 210500

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SECTION 211000 - WATER-BASED FIRE-SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. Description of Work:

1. The work includes designing and providing an automatic fire extinguishing system of required hazard for building occupancy to afford complete fire protection coverage throughout. The design, equipment, materials, installation and workmanship shall be in strict accordance with the Owners insurance underwriters requirements, the North Carolina Statewide Building Code and Fire Prevention Code, Local AHJ and the required and advisory provisions of NFPA.
2. Unless otherwise indicated piping shall not be run in spaces containing electrical equipment in the form of transformers, panel-boards, switchgear, or computer servers.
 - a. Exceptions:
 - 1) Personal computers (PC,s)
 - 2) Spaces whose name does not include the term "Electrical", "Data", or "Computer"
3. Each system shall include materials, accessories and equipment necessary to provide each system complete and ready for use.
4. The design of each system shall give full consideration to blind spaces, piping, electrical equipment, ductwork, and all other construction and equipment to afford complete coverage.
5. Devices and equipment for fire protection service shall be of an approved make and type listed by the Underwriters' Laboratories, Inc., or approved by the Factory Mutual System.
6. In the publications referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears.
7. Reference to the "authority having jurisdiction" shall be interpreted to mean the Local Fire Marshal..
8. The work shall begin outside the building at a point five feet from the exterior surface of the wall at the location indicated on the drawings.

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9. Calculations shall include delivering water from the point of the fire hydrant flow test through the site piping.
10. Consideration shall be given to all unheated areas such as attics, utility rooms, loading docks, outdoor storage spaces with canopies, etc., to provide freeze protection in accordance with NFPA 13. This shall include the installation of dry sprinklers or a dry-pipe sprinkler systems where necessary.

1.3 DEFINITIONS

- A. Underground Service-Entrance Piping: Underground service piping below the building.

1.4 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.

1.5 PERFORMANCE REQUIREMENTS

- A. Standard Piping System Component Working Pressure: Listed for at least 175 psig.
- B. Fire-suppression sprinkler system design shall be approved by authorities having jurisdiction.
 1. Margin of Safety for Available Water Flow and Pressure: **10** percent, including losses through water-service piping, valves, and backflow preventers or 10 psi whichever is greater.
 2. Sprinkler Occupancy Hazard Classifications: **shall be as indicated on the drawings.**
 3. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. (6.3 mL/s over 139-sq. m) area.
 - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. (9.5 mL/s over 139-sq. m) area.
 - c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. (12.6 mL/s over 139-sq. m) area.
 4. Maximum Protection Area per Sprinkler:
 - a. Office Spaces: 225 sq. ft. (20.9 sq. m).
 - b. Storage Areas: 130 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.

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5. Total Combined Hose-Stream Demand Requirement: According to NFPA 13, unless otherwise indicated:
 - a. Light-Hazard Occupancies: 100 gpm (6.3 L/s) for 30 minutes.
 - b. Ordinary-Hazard Occupancies: 250 gpm (15.75 L/s) for 60 to 90 minutes.

1.6 SUBMITTALS

A. Product Data: For the following:

1. Piping materials, including sprinkler specialty fittings.
2. Pipe hangers and supports.
3. Valves, including listed fire-protection valves, unlisted general-duty valves, and specialty valves and trim.
4. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.
5. Hose connections, including size, type, and finish.
6. Fire department connections, including type; number, size, and arrangement of inlets; caps and chains; size and direction of outlet; escutcheon and marking; and finish.
7. Alarm devices, including electrical data.
8. Grooved joint couplings and fittings shall be shown on drawings and product submittals, and be specifically identified with the applicable Victaulic style number.

B. Fire-hydrant flow test report.

Approved Sprinkler Piping Shop Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations. Diagram power, signal, and control wiring.

1. Include shop drawings indicating location of all sprinkler heads and all other construction that penetrates ceilings, including light fixtures, HVAC equipment, speakers, fire alarm devices, partition assemblies, etc.
2. Sprinklers shall be referred to on drawings, submittals and other documentation, by the sprinkler identification or Model number as specifically published in the appropriate agency listing or approval. Trade names or other abbreviated designations shall not be allowed.

C. Welding certificates.

D. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.7 CLOSEOUT SUBMITTALS

1. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in **NFPA 13**. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. A Professional Engineer registered in the state where the project is constructed shall stamp and seal the Shop Drawings.

B. Flow test:

1. Bid shall be based on the indicated fire-hydrant flow and pressure.
2. Design calculations shall be based on the results of a confirming fire-hydrant flow test performed or caused to be performed by the contractor.

C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

D. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

1. All castings used for couplings housings, fittings, or valve and specialty bodies shall be date stamped for quality assurance and traceability.
2. Any couplings requiring a torque wrench, per manufacturer installation instruction, must have a test tag attached to each bolt showing torque used for each. Tags shall be date stamped and initialed by the installer.

E. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, 2019 edition "Installation of Sprinkler Systems."

1.9 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

B. Coordination for exposed sprinkler piping:

1. The intent for this coordination is to reduce the visibility of exposed sprinkler piping within exposed spaces. The shop drawings shall identify exposed areas to eliminate exposed sprinkler piping as much as possible.
2. For clear stories: Coordinate Sprinkler piping to avoid piping be installed in front of glazing assemblies. Where routing shall be in between windows or in front of mullions for a neat exposed appearance approved by Architect.
3. For roof height elevation changes in exposed areas: Limit Sprinkler piping to 1 or 2 locations within a single open space to reduce visibility of vertical piping. Sprinkler mains shall not be routed in exposed areas unless required. If required the main locations shall be coordinated with Architect.

4. Where vertical exposed piping occurs the piping shall be installed along the wall and in the corner to reduce visibility.

1.10 SPRINKLER CABINET(S) AND SPARE SPRINKLERS

- A. Provide finished, wall-mounted, steel sprinkler cabinet with hinged cover.
- B. Provide space for minimum of six spare sprinklers and sprinkler wrench.
- C. Provide minimum of six spare sprinklers and sprinkler wrench in cabinet.
- D. Provide number of sprinklers required by NFPA 13.
- E. Provide separate cabinet with sprinklers and wrench for each type of sprinkler on Project.
- F. Provide products packaged with protective covering for storage. Identify contents with label.

1.11 STEEL PIPE AND FITTINGS

- A. Threaded-End, Schedule 40 Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, with factory- or field-formed threaded ends.
 1. Cast-Iron Threaded Flanges: ASME B16.1.
 2. Malleable-Iron Threaded Fittings: ASME B16.3.
 3. Gray-Iron Threaded Fittings: ASME B16.4.
 4. 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.
 5. Steel Threaded Couplings: ASTM A 865.
- B. Plain-End, Schedule 40 Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795.
 1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.
 2. Steel Flanges and Flanged Fittings: ASME B16.5.
- C. Grooved-End, Schedule 40 Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, with factory- or field-formed, square-cut- or roll-grooved ends.
 1. Grooved-Joint Piping Systems:
 - a. **Available Manufacturers:**
 - 1) Victaulic Co. of America.
 - b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD. In applicable sizes, fittings shall be short-pattern, with flow equal to standard pattern fittings. Victaulic FireLock.
 - c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron

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housing with keys matching steel-pipe and fitting grooves, prelubricated rubber gasket listed for use with housing, and ASTM A449 compliant steel bolts and nuts.

- 1) Rigid Type: Housings cast with offsetting, angle-pattern, bolt pads to provide system rigidity and support and hanging in accordance with NFPA-13, fully installed at visual pad-to-pad offset contact. Installation-Ready for complete installation without field disassembly. Basis of Design: Victaulic Style 009N and 107N.
 - a) Installation Ready™ rigid single-bolt coupling, Victaulic Style 109, in sizes NPS 1-1/4 (DN32) through NPS 2-1/2 (DN65).
 - 2) Flexible Type: For use in locations where vibration attenuation and stress relief are required: Basis of Design: Victaulic Installation-Ready Style 177 or Style 77.
 - 3) Installation ready gaskets are center-leg, with pipe stop to ensure proper groove engagement, alignment, and pipe insertion depth.
- d. Installation-Ready™ fittings for Schedule 10 grooved end steel piping in fire protection applications sizes NPS 1-1/4 thru 2 1/2 (DN 32 thru DN 65). Fittings shall consist of a ductile iron housing conforming to ASTM A-536, Grade 65-45-12, with Installation-Ready™ ends, orange enamel coated. Fittings complete with prelubricated Grade “E” EPDM Type ‘A’ gasket; and ASTM A449 electroplated steel bolts and nuts. System shall be UL listed for a working pressure of 300 psi (2065 kPa) and FM approved for working pressure 365 psi (2517kPa).
- 1) Victaulic FireLock IGS System with “Installation-Ready™ fittings and couplings may be used for NPS 1 (DN 25) Schedule 10 and Schedule 40 carbon steel pipe in fire protection applications. System rated for a working pressure to 365 psi (2517 kPa).
 - 2) Groove: IGS “Innovative Groove System” groove with shortened “A” dimension and tapered groove backside for ease of installation.
 - 3) Grooving Tool: Victaulic RG2100, with IGS Confirmation Gauge.
- D. Grooved-End, Schedule 10 Steel Pipe: Schedule 10 in NPS 5 (DN 125) and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10 (DN 150 to DN 250); with factory- or field-formed, roll-grooved ends.
1. Grooved-Joint Piping Systems:
 - a. Manufacturers:
 - 1) Victaulic Co. of America.
 - b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD. In applicable sizes, fittings shall be short-pattern, with flow equal to standard pattern fittings. Victaulic FireLock.
 - 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, prelubricated rubber gasket listed for use with housing, and ASTM A449 compliant steel bolts and nuts.

- 1) Rigid Type: Housings cast with offsetting, angle-pattern, bolt pads to provide system rigidity and support and hanging in accordance with NFPA-13, fully installed at visual pad-to-pad offset contact. Installation-Ready for complete installation without field disassembly. Basis of Design: Victaulic Style 009N and 107N.
 - a) Installation Ready™ rigid single-bolt coupling, Victaulic Style 109, for sizes [cULus, FM], in sizes NPS 1-1/4 (DN32) through NPS 2-1/2 (DN65) sizes.
 - 2) Installation ready gaskets are center-leg, with pipe stop to ensure proper groove engagement, alignment, and pipe insertion depth.
- d. Installation-Ready™ fittings for Schedule 10 grooved end steel piping in fire protection applications sizes NPS 1-¼ thru 2½ (DN 32 thru DN 65). Fittings shall consist of a ductile iron housing conforming to ASTM A-536, Grade 65-45-12, with Installation-Ready™ ends, orange enamel coated. Fittings complete with prelubricated Grade “E” EPDM Type ‘A’ gasket; and ASTM A449 electroplated steel bolts and nuts. System shall be UL listed for a working pressure of 300 psi (2065 kPa) and FM approved for working pressure 365 psi (2517kPa).
- 1) Victaulic FireLock IGS System with “Installation-Ready™ fittings and couplings may be used for NPS 1 (DN 25) Schedule 10 and Schedule 40 carbon steel pipe in fire protection applications. System rated for a working pressure to 365 psi (2517 kPa).
 - 2) Groove: IGS “Innovative Groove System” groove with shortened “A” dimension and tapered groove backside for ease of installation.
- ~~2.~~ Union joints shall be provided for ease of installation.

1.12 SPRINKLER SPECIALTY FITTINGS

- A. 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. Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic Company.

1.13 LISTED FIRE-PROTECTION VALVES

- A. Valves shall be UL listed or FMG approved, with 175-psig minimum pressure rating.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic Company.
- B. OS&Y Gate Valves: UL 262.

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1. Ductile-iron body with flanged x Groove or groove x groove ends. No Flange x Flange will be accepted.
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic Company or engineer approved equal. Basis of design Victaulic model 771H or 771F.
- C. Ball Valves: Comply with UL 1091, except with ball instead of disc.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic Company.
 2. NPS 1-1/2 and Smaller: Bronze body with grooved ends. Basis of Design: Victaulic Series 728.
 3. NPS 2 and NPS 2-1/2: ductile-iron body with grooved ends.
 4. NPS 3: Ductile-iron body with grooved ends.
- D. Butterfly Valves: UL 1091.
 1. NPS 2 and Smaller: Bronze body with grooved ends.
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic Company.
 2. NPS 2-1/2 and Larger: Bronze, cast-iron, or ductile-iron body; wafer type or with flanged or grooved ends. Valve seat shall be pressure-responsive, and the stem offset from the disc centerline to provide complete 360-degree circumferential seating. Basis of Design: Victaulic Series 705. Each valve must be individually tested at factory to include electronics.
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic Company.
- E. Check Valves NPS 2 and Larger: UL 312, spring-assisted swing type for vertical or horizontal installation, cast- ductile iron body with flanged or grooved ends. Basis of Design: Victaulic Series 717.
- F. Indicating Valves: UL 1091, with integral indicating device and ends matching connecting piping.
 1. Indicator: Weatherproof actuator housing with electrical, 15 amp @125-VAC 60 HZ, prewired, single-pole-single-throw, supervisory switches
 2. NPS 2 and Smaller: Ball or butterfly valve with bronze body with grooved ends. Basis of Design: Victaulic Series 728.
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic Company.
 3. NPS 2-1/2 and Larger: Butterfly valve with cast- or ductile-iron body; wafer type or with flanged or grooved ends.

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- a. Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic Company.

1.14 GENERAL-DUTY VALVES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic Company.
- B. Ball Valves NPS 2 and Smaller: MSS SP-110, 2-piece copper-alloy body with chrome-plated brass ball, 600-psig minimum CWP rating, blowout-proof stem, and threaded ends.
- C. Check Valves NPS 2 and Smaller: MSS SP-80, Type 4, Class 125 minimum, swing type with bronze body, nonmetallic disc, and threaded ends.
- D. Globe Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, nonmetallic disc, and threaded ends.

1.15 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 minimum pressure rating.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic Company or engineer approved equal
 - 2. Riser 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 drain and pressure gages.
 - 3. Floor control valve assemblies: Universal Manifold Check Valve | Model UMC
Model UMC - 1-1/4, 1-1/2, 2, 2-1/2, 3, 4, 6, and 8-inch Universal Manifold Check Valve: Where universal manifold check valves are specified for use in wet-pipe sprinkler systems, as floor control manifolds they shall be specifically listed for such use. Universal manifold check valves shall be ductile iron construction, incorporating a control valve, check valve, flow switch, test & drain assembly, adjustable relief valve, and system gauges in one compact body/footprint, and shall be manufactured for "right" and "left"-hand orientations. The test & drain assembly shall contain an adjustable relief valve, with a range of 175 to 310 psi, and a universal test orifice of K2.8; to provide testing capabilities of systems with k-factors ranging from K2.8 and larger. The Universal Manifold Check valve shall be rated for use at the maximum service pressure of 300 psi and shall be UL listed and FM approved. Universal manifold check valves shall be the Model UMC; as manufactured by Globe brand by Victaulic Company.

1.16 SPRINKLERS

- A. Sprinklers shall be UL listed or FMG approved, with 175-psig minimum pressure rating. Basis of design Victaulic/Globe.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic Company or engineer approved equal
- C. Automatic Sprinklers: UL-Listed with quick response glass bulb type heat-responsive element complying with the following:
 - 1. UL 199, for nonresidential applications.
- D. Wrenches shall be provided by the sprinkler manufacturer that directly engage the hex-shaped wrench boss integrally cast in the sprinkler body.
- E. Sprinkler types, features, and options as follows:
 - 1. Brass upright sprinklers.
 - 2. Extended-coverage sprinklers.
 - 3. Concealed pendent sprinklers, including cover plate.
 - 4. Pendent sprinklers.
 - 5. Pendent, dry-type sprinklers.
 - 6. Quick-response sprinklers.
 - 7. Recessed sprinklers, including escutcheon.
 - 8. Sidewall sprinklers.
 - 9. Sidewall, dry-type sprinklers.
 - 10. Institutional – Tyco RAVEN is preferred manufacturer
- F. 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: 2 piece, with 1-inch vertical adjustment.
 - 2. Sidewall Mounting: 2 piece, with 1-inch horizontal adjustment.
- G. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.
- H. For cooler or Freezer boxes: Victaulic AB6 Freezer dry pendant utilizing a flexible hose connection shall be used. No dry Pendant utilizing a rubber boot will be allowed.
- I. For Vestibules: Install dry type horizontal sidewall sprinklers.

1.17 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Wet Pipe Water-Flow Indicator: UL 346, electrical-supervision, paddle-operated-type, water-flow detector with 250-psig pressure rating and designed for horizontal or vertical installation.

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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. Available Manufacturers:
 - a. Grinnell Fire Protection.
 - b. ITT McDonnell & Miller.
 - c. Potter Electric Signal Company.
 - d. Viking Corp.
 - e. 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. Available Manufacturers:
 - a. McWane, Inc.; Kennedy Valve Div.
 - b. Potter Electric Signal Company.
 - c. System Sensor.

PART 2 - EXECUTION

2.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in Part 1 "Quality Assurance" Article.
- B. Report test results promptly and in writing.

2.2 EARTHWORK

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

2.3 EXAMINATION

- A. Examine walls and partitions for suitable thicknesses, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

2.4 SPRINKLER SYSTEM PIPING APPLICATIONS

- A. Standard-Pressure, Wet-Pipe Sprinkler System, 175-psig (1200-kPa) Maximum Working Pressure:

1. Sprinkler Piping NPS 2" and smaller use any of the following:
 - a. Threaded-end, black, schedule 40 steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.
 - b. Plain-end, black, schedule 40 steel pipe; steel welding fittings; and welded joints.
 - c. Grooved-end, black, schedule 40 steel pipe with square-cut- or roll-grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
2. Sprinkler Piping NPS 2 1/2" and larger use any of the following:
 - a. Threaded-end, black, schedule 40 steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.
 - b. Plain-end, black, schedule 10 steel pipe; steel welding fittings; and welded joints.
 - c. Grooved-end, black, Schedule 10 steel pipe; grooved-end fittings; grooved-end-pipe couplings; and roll grooved joints.

2.5 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.
 - a. Shutoff Duty: Use ball, butterfly, or gate valves.
 2. Unlisted General-Duty Valves: For applications where UL-listed and FMG-approved valves are not required by NFPA 13
 - a. Shutoff Duty: Use ball, butterfly, or gate valves.
 - b. Throttling Duty: Use ball or globe valves.

2.6 JOINT CONSTRUCTION

- A. Refer to Division 21 Section "Common Work Results for Fire Suppression" 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.
- D. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials.
 1. NPS 2 and Smaller: Use dielectric unions, couplings, or nipples.

2. NPS 2-1/2 to NPS 4: Use dielectric flanges.

2.7 WATER-SUPPLY CONNECTION

- A. Connect fire-suppression piping to building's interior water distribution piping. Refer to Division 22 Section "Domestic Water Piping" for interior piping.
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water distribution piping. Refer to Division 22 Section "Domestic Water Piping Specialties" for backflow preventers.
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

2.8 PIPING INSTALLATION

- A. Refer to Division 21 Section "Common Work Results for Fire Suppression" 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. Piping shall be exposed in spaces without ceilings only if supplying sprinklers in the same space.
 2. The only piping allowed over rooms containing electrical equipment in the form of , transformers, panelboards, switchgear, or computer servers shall be pipes serving sprinklers within each electrical equipment space.
 - a. Exception:
 - 1) Generator or transformer rooms separated from the remainder of the building by walls and floor/ceiling or roof/ceiling assemblies having a fire-resistance rating of not less than two hours shall not require sprinkler coverage provided that such rooms are protected with an approved automatic fire detection system.
 3. 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 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 and larger connections.
- F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13. Test connections that discharge to the exterior shall

discharge 1'-0" above a concrete splash block. Provide splash block under this section of the specifications.

- G. Install sprinkler piping with drains for complete system drainage.
- H. Install alarm devices in piping systems.
- I. Hangers and Supports: Comply with NFPA 13 and "Hanger and Supports for Fire-Suppression Piping" for hanger materials.
 - 1. Install sprinkler system piping according to NFPA 13.
- J. Fill wet-pipe sprinkler system piping with water.

2.9 VALVE INSTALLATION

- A. Install listed fire-protection valves, unlisted general-duty valves, specialty valves and trim, controls, and specialties according to NFPA 13 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.
- C. Valves for Wall-Type Fire Hydrants: Install nonrising-stem gate valve in water-supply pipe.
- D. Install backflow preventer in potable-water supply sources.
- E. Specialty Valves:
 - 1. Alarm Check Valves: Install in vertical position for proper direction of flow, including bypass check valve and retarding chamber drain-line connection.

2.10 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.
 - 2. Rooms with Suspended Ceilings above 10'-0": semi-recessed pendent sprinklers unless otherwise indicated.
 - 3. Rooms with suspended ceilings less than 10'-0": Concealed pendent type sprinklers unless otherwise indicated.
 - 4. Spaces subject to damage from inmate abuse: Tyco Raven institutional Pendent or sidewall type.
 - 5. Wall Mounting: Recessed Sidewall sprinklers.
 - 6. Spaces Subject to Freezing: Dry upright, dry pendent, or dry sidewall sprinklers as indicated.
 - 7. Special Applications: quick-response sprinklers where indicated or required.
 - 8. Sprinkler Finishes:

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- a. Pendent, and Sidewall Sprinklers: wax coated where exposed to acids, chemicals, or other corrosive fumes.
- b. Upright: shall be a brass finish.

2.11 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings centered both ways in 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 wherever possible. Otherwise, use dry-pipe systems.

2.12 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. Include backflow preventer between potable-water piping and fire-suppression piping. Refer to Division 22 Section "Domestic Water Piping Specialties" for backflow preventers.
- D. Electrical Connections: Power wiring is specified in Division 26.
- E. Coordinate connection of alarm devices to fire alarm.
- F. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- G. Coordinate connection of wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- H. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

2.13 LABELING AND IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements as indicated in Wake County Stanadards. Refer to Wake County Faciltiies Design & Construction Guidelines & Standards for additional details, <https://www.wake.gov/departments-government/facilities-design-construction/facilities-design-construction-guidelines-standards>.

2.14 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:

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1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Energize circuits to electrical equipment and devices.
4. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
5. Coordinate with fire alarm tests. Operate as required.
6. Verify that equipment hose threads are same as local fire department equipment.

- B. Report test results promptly and in writing to Architect and authorities having jurisdiction.

2.15 CLEANING AND PROTECTION

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.
- C. Protect sprinklers from damage until Substantial Completion.
- D. Coordinate location of discharge of drains, operating drains and test connection prior to discharging of water. Protect the exterior of the building when operating drains and test connections that discharge to the exterior.
- E. Dirt and stains on any surfaces resulting from the work of this section of the specifications shall be cleaned and removed under this section of the specifications.

2.16 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves. Refer to Division 01 Section Closeout Procedures

END OF SECTION 211000

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 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.
- F. The following are industry abbreviations for plastic materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. CPVC: Chlorinated polyvinyl chloride plastic.
 - 3. PE: Polyethylene plastic.
 - 4. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.3 SUBMITTALS

- A. Product Data: For the following:
 - 1. Transition fittings.
 - 2. Dielectric fittings.

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- 3. Mechanical sleeve seals.
- 4. Escutcheons.

1.4 QUALITY ASSURANCE

- A. Wake County Compliance: Comply with Wake County Standards. Refer to Wake County Facilities Design & Construction Guidelines & Standards.
<https://www.wake.gov/departments-government/facilities-design-construction/facilities-design-construction-guidelines-standards>.
- B. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- C. 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.
- D. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.6 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to Division 23 Hydronic Piping or 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 joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions inside & outside pipe and:
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is otherwise 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.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated, and full-face or ring type, unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free (95% Tin, 5% Antimony) alloy. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- E. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- F. Solvent Cements for Joining Plastic Piping:
 - 1. ABS Piping: ASTM D 2235.
 - 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - 3. PVC to ABS Piping Transition: ASTM D 3138.

2.3 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
 - 1. Available Manufacturers:

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- a. Cascade Waterworks Mfg. Co.
 - b. Dresser Industries, Inc.; DMD Div.
 - c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
 - d. JCM Industries.
 - e. Smith-Blair, Inc.
 - f. Viking Johnson.
 2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
 3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
 4. Aboveground Pressure Piping: Pipe fitting.
- B. Plastic-to-Metal Transition Fittings: CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
1. Available Manufacturers:
 - a. Eslon Thermoplastics.

2.4 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 Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
1. Available Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Epco Sales, Inc.
 - d. Watts Industries, Inc.; Water Products Div.
- D. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 2. Separate companion flanges and steel bolts and nuts shall have 150 or 300 psig working pressure where required to suit system pressures.

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- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

1. Available Manufacturers:

- a. Calpico, Inc.
- b. Lochinvar Corp.

2.5 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Available Manufacturers:

- a. Advance Products & Systems, Inc.
- b. Calpico, Inc.
- c. Metraflex Co.
- d. Pipeline Seal and Insulator, Inc.

- 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- 3. Pressure Plates: Plastic. Include two for each sealing element.
- 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.6 SLEEVES

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

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2.7 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.
- E. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.8 GROUT

- A. Description: ASTM C 1107, Grade B, non-shrink and non-metallic, 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, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.9 SECURITY FASTENERS:

- A. Description: Accessories, anchorage inserts, and security fasteners providing complete tamperproof installation.
- B. Exposed Security Fasteners:
 - 1. Fastener: Provide torx-head (star with center reject pin) security fasteners for anchoring work in exposed security areas.
 - 2. Finish: Finish shall match that specified of the item anchored.
 - 3. Tools: Provide tools for fastening devices

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.

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- g. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
 - h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves aboveground are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through walls, floors, or roofs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves as walls and slabs are constructed.
 - a. PVC Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
 - 3. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- P. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- Q. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

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1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Section "Penetration Firestopping" for materials.
- S. Verify final equipment locations for roughing-in.
- T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

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1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
5. PVC Non-pressure Piping: Join according to ASTM D 2855.
6. PVC to ABS Non-pressure Transition Fittings: Join according to ASTM D 3138 Appendix.

- J. Plastic Non-pressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. 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 PAINTING

- A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 HOUSEKEEPING PADS AND EQUIPMENT PADS

- A. Housekeeping pads and equipment pads: Anchor equipment to concrete according to equipment manufacturer's written instructions and according to seismic codes at project location.
 - 1. Construct concrete pads in accordance with drawing details.
 - 2. Details may be found on structural drawings. If details are not provided comply with the following:
 - a. Housekeeping pads inside the building shall be 4" thick and 6" larger all around than supported equipment. Provide a 1" chamfer on all edges.
 - b. If details are not provided, equipment pads outside the building shall be 8" thick with a 24" deep 12" wide turndown (footing) all around the outside edge of the pad. Provide welded wire mesh reinforcement. Pad shall be 12" larger all around than supported equipment.
 - c. Install dowel rods to connect housekeeping pad to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the pad. Provide a 1" chamfer on all edges.
 - d. Install epoxy-coated anchor bolts. For equipment on housekeeping pads bolts shall extend through housekeeping pad, and anchor into structural concrete floor.
 - e. Place and secure anchor bolts using supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions for placement.
 - f. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - g. Install anchor bolts according to anchor bolt manufacturer's written instructions.
 - h. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Section "Cast-in-Place Concrete".

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.8 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.

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- 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 220513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 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 plumbing equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet 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. Premium efficiency motors shall meet the following full load efficiency:

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HP	ODP			TEFC		
	6 Pole	4 Pole	2 Pole	6 Pole	4 Pole	2 Pole
1	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2	87.5	86.5	85.5	88.5	86.5	85.5
3	88.5	89.5	85.5	89.5	89.5	86.5
5	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10	91.7	91.7	89.5	91.0	91.7	90.2
15	91.7	93.0	90.2	91.7	92.4	91.0
20	92.4	93.0	91.0	91.7	93.0	91.0
25	93.0	93.6	91.7	93.0	93.6	91.7
30	93.6	94.1	91.7	93.0	93.6	91.7
40	94.1	94.1	92.4	94.1	94.1	92.4
50	94.1	94.5	93.0	94.1	94.5	93.0
60	94.5	95.0	93.6	94.5	95.0	93.6
75	94.5	95.0	93.6	94.5	95.4	93.6
100	95.0	95.4	93.6	95.0	95.4	94.1
125	95.0	95.4	94.1	95.0	95.4	95.0

- C. Efficiency: Premium
- D. Stator: Copper windings, unless otherwise indicated.
- E. Rotor: Squirrel cage, unless otherwise indicated.
- F. Bearings: Double-shielded, pre-lubricated ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating, unless otherwise indicated.
- H. Insulation: Class F, unless otherwise indicated.
- I. Code Letter Designation: NEMA starting Code F or G.
- J. Enclosure: Cast iron.
- K. Finish: Gray enamel.
- L. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

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2.4 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. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Pre-lubricated, anti-friction 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 220513

SECTION 220516 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
- B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Maintenance Data: For expansion joints to include in maintenance manuals.

1.4 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 PACKLESS EXPANSION JOINTS

- A. Flexible-Hose Packless Expansion Joints:
 - 1. Available Manufacturers:
 - a. Flex-Hose Co., Inc.
 - b. Flexicraft Industries.
 - c. Flex Pression Ltd.
 - d. Metraflex, Inc.
 - e. Unisource Manufacturing, Inc.
 - 2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
 - 3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.

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4. Expansion Joints for Copper Tubing NPS 2 and Smaller: Copper-alloy fittings with solder-joint end connections.
 - a. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.
5. Expansion Joints for Copper Tubing 2-1/2" to 4": Copper-alloy fittings with threaded end connections.
 - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.

2.2 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:

1. Available Manufacturers:
 - a. Adsko Manufacturing LLC.
 - b. Advanced Thermal Systems, Inc.
 - c. Flex-Hose Co., Inc.
 - d. Flexicraft Industries.
 - e. Flex-Weld, Inc.
 - f. Hyspan Precision Products, Inc.
 - g. Metraflex, Inc.
 - h. Unisource Manufacturing, Inc.
2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
 - a. Stud: Threaded, zinc-coated carbon steel.
 - b. Expansion Plug: Zinc-coated steel.
 - c. Washer and Nut: Zinc-coated steel.
5. Chemical Fasteners: Insert-type-stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
 - a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.

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- b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud unless otherwise indicated.
- c. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.1 EXPANSION-JOINT INSTALLATION

- A. Install expansion joints of sizes matching sizes of piping in which they are installed.
- B. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
- C. Install rubber packless expansion joints according to FSA-NMEJ-702.

3.2 PIPE LOOP AND SWING CONNECTION INSTALLATION

- A. Connect risers and branch connections to mains with a minimum of 5 (five) pipe fittings including tee in main.
- B. Connect risers and branch connections to terminal units with a minimum of 4 (four) pipe fittings including tee in riser.
- C. Connect mains and branch connections to terminal units with a minimum of 4 (four) pipe fittings including tee in main.

3.3 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

- A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
- B. Install two guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four Insert number pipe diameters from expansion joint.
- C. Attach guides to pipe and secure guides to building structure.
- D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- E. Anchor Attachments:
 - 1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.

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- F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
 - 1. Anchor Attachment to Steel Structural Members: Attach by welding.
 - 2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.

- G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION 220516

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of one-piece cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

2.2 STACK-SLEEVE FITTINGS

- A. Available Manufacturers:
 - 1. Smith, Jay R. Mfg. Co.
 - 2. Wade
 - 3. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
- B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.

2.3 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

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1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. GPT, EnPro Industries
 - d. Metraflex Co.
 - e. Pipeline Seal and Insulator, Inc.
2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Plastic. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 1. Cut sleeves to length for mounting flush with both surfaces.
 2. Install sleeves that are large enough to provide 1/4" clear space between sleeve and pipe or pipe insulation.
 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants.
- E. Fire Ratings: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

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3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
 - 1. Install fittings that are large enough to provide ¼" clear space between sleeve and pipe or pipe insulation.
 - 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Division 07 Section "Sheet Metal Flashing and Trim."
 - 3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
 - 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 5. Using grout, seal the space around outside of stack-sleeve fittings.
- B. Fire Rating: Maintain indicated fire rating at pipe penetrations. Seal pipe penetrations with firestop materials.

3.3 SLEEVE-SEAL SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building unless otherwise indicated.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Exterior Concrete Walls above Grade, below Grade, Concrete Slabs-on-Grade, and Concrete Slabs above Grade:
 - a. Piping Smaller Than 6": Cast-iron wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for one inch (1") annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping 6" and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system.

END OF SECTION 220517

SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

- A. CR: Chlorosulfonated polyethylene synthetic rubber.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Schedule for thermometers and gages indicating manufacturer's number, scale range, and location for each.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

- A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
 - 1. Manufacturers:
 - a. Flo Fab Inc.
 - b. Miljoco Corporation.
 - c. Palmer Wahl Instrumentation Group.
 - d. Tel-Tru Manufacturing Company.
 - e. Trerice, H. O. Co.
 - f. Weiss Instruments, Inc.
 - g. Winters Instruments - U.S.
 - 2. Standard: ASME B40.200.
 - 3. Case: Cast aluminum; 9-inch nominal size unless otherwise indicated.
 - 4. Case Form: Adjustable angle unless otherwise indicated.
 - 5. Tube: Glass with magnifying lens and blue or red organic liquid.
 - 6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in degrees F.
 - 7. Window: Glass

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8. Stem: Aluminum length = 1/2 pipe diameter, 1/2 duct width or 12" whichever is less.
 - a. Air-Duct Installation: Provide ventilated shroud.
 - b. Thermowell Installation: Provide Bare stem.
9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into threaded fitting.
3. Material: Brass.
4. Type: Stepped shank unless straight or tapered shank is indicated.
5. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
6. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
7. Bore: Diameter required to match thermometer bulb or stem.
8. Insertion Length: Length required to match thermometer bulb or stem.
9. Lagging Extension: Include on thermowells for insulated piping and tubing.
10. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

2.3 PRESSURE GAGES

A. Available Manufacturers:

1. Terice, H. O. Co.
2. Weiss Instruments, Inc.
3. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
4. Miljoco Corporation

B. Direct or remote-Mounting, Dial-Type Pressure Gages: Indicating-dial type.

1. Case: Rear flange dry type, drawn steel or cast aluminum, 4-1/2-inch diameter.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Red or other dark-color metal.
7. Window: Glass or acrylic.
8. Ring: Stainless steel or brass.
9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
11. Range for Fluids under Pressure: Two times operating pressure.

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- C. Pressure-Gage Fittings:
 - 1. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.4 TEST PLUGS

- A. Available Manufacturers:
 - 1. Trerice, H. O. Co.
 - 2. Weiss Instruments, Inc.
 - 3. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
 - 4. Miljoco Corporation
- B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.
- C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- D. Core Inserts: One or two self-sealing rubber valves.
 - 1. Insert material for water service at 20 to 200 deg F shall be CR.
 - 2. Insert material for water service at minus 30 to plus 275 deg F shall be EPDM.

2.5 ISOLATION VALVES

- A. Available Manufacturers:
 - 1. Trerice, H. O. Co.
 - 2. Weiss Instruments, Inc.
 - 3. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
 - 4. Miljoco Corporation.
- B. Description: Brass ball valve or 316 stainless steel needle valve.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install direct-mounting thermometers and adjust vertical and tilted positions.
- B. Install remote-mounting dial thermometers on panel, with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length.
- C. Install thermowells with socket extending to center of pipe and in vertical position in piping tees for each gauge and thermometer.

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- D. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.
- E. Install needle-valve and snubber fitting in piping for each pressure gage.
- F. Install test plugs.
- G. Adjust faces of thermometers and gages to for proper visibility as judged by the architect.

END OF SECTION 220519

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. PTFE: Polytetrafluoroethylene plastic.
- G. RS: Rising stem.
- H. SWP: Steam working pressure.
- I. TFE: Tetrafluoroethylene plastic.
- J. WOG: Water Oil Gas.

1.3 SUBMITTALS

- A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include furnished specialties and accessories.

1.4 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 2. ASME B31.1 for power piping valves.

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- 3. ASME B31.9 for building services piping valves.
 - a. Exceptions: Domestic hot- and cold-water valves unless referenced.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Bronze & Brass: Shall be dezincification resistant. (Zinc content shall be less than 15%)
- C. Bronze Valves: NPS 2 and smaller with threaded ends, unless otherwise indicated.
- D. Ferrous Valves: NPS 2-1/2 and larger with flanged ends, unless otherwise indicated.
- E. Valve Pressure and Temperature Ratings: Match system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valve Actuator Types:
 - 1. As specified in other Part 2 articles.
 - 2. Where required in Part 3 articles, provide a chain actuator in lieu of the operator specified in other Part 2 articles.

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3. Chain Operator: For attachment to valves, of size and mounting height, as indicated in the "Valve Installation" Article in Part 3.
4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.
5. 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.

H. Valves in Insulated Piping: With 2-inch 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.

I. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.
3. Solder Joint: With sockets according to ASME B16.18.
4. Threaded: With threads according to ASME B1.20.1.

J. Valve Bypass and Drain Connections: MSS SP-45.

2.2 COPPER-ALLOY BALL VALVES

A. Two-Piece, Copper-Alloy Ball Valves (Full Port):

1. NIBCO Model 585-70-66 (Uninsulated piping)
2. NIBCO Model 585-70-66NS or approved alternative (Insulated piping)
3. Other Manufacturers:
 - a. Milwaukee
 - b. Conbraco Industries, Inc.; Apollo Div.
4. Handle Nut: 300 series stainless steel.
5. Handle: Zinc plated steel, clear chromate, plastic coated.
6. Threaded Pack Gland: Brass ASTM B-16 Alloy 360
7. Packing: TFE
8. Stem (Blowout Proof): ASTM A-276 type 316 stainless steel. Where piping is insulated provide 2" extended handles of non-thermal conductive material. Also provide a protective sleeve that allows operation of the valve without breaking the vapor seal or disturbing the insulation. Memory stops, which are fully adjustable after insulation is applied, shall be included.
9. Thrust Washer: Reinforced TFE
10. Ball: Full-port, ASTM A-276 Type 316 stainless steel.
11. Seats: Reinforced TFE
12. Body: Bronze ASTM B-584 alloy 844 for solder or threaded connection.
13. Body End Piece: Bronze ASTM B-584 alloy 844 for solder or threaded connection.
14. Rating: 150 psig saturated steam, 600 psig non-shock cold water, oil, and gas.
15. Conform To: MSS SP-110

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2.3 MOTORIZED BALL VALVES

A. Electrically Operated Valves: Comply with UL 429.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ASCO Power Technologies, LP; Division of Emerson. Model 8210
 - b. Magnatrol Valve Corporation.
 - c. Parker Hannifin Corporation; Climate & Industrial Controls Group; Skinner Valve Div.
 - d. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
 - e. Valworx Inc. Valves & Controls.
2. Pilot operated.
3. Body: Brass or aluminum.
4. Seats and Disc: Nitrile rubber.
5. Springs and Valve Trim: Stainless steel.
6. 120-V ac, 60 Hz, Class B, continuous-duty molded coil, and replaceable.
7. NEMA ICS 6, Type 4, coil enclosure.
8. Normally closed.
9. Visual position indicator.

2.4 FERROUS-ALLOY BUTTERFLY VALVES

A. General: Butterfly valves shall provide bi-directional bubble tight dead-end service without a downstream flange.

B. Wafer-lug type butterfly valves:

1. NIBCO Model LD 2000
2. Other Manufacturers:
 - a. Stockham
 - b. Demco
3. Stem: ASTM A-582 Type 416 Stainless steel.
4. Collar Bushing: ASTM B-124 Brass.
5. Stem Seal: EPDM Rubber
6. Body Seal: EPDM Rubber
7. Upper Bushing: CDA 122 Copper
8. Liner: EPDM Rubber
9. Disc: ASTM B-148 alloy 954/955 aluminum bronze.
10. Lower Bushing: CDA 122 copper.
11. Body Wafer: ASTM A-536 Ductile Iron or ASTM A-126 CL. B cast iron.
12. Body Lug: ASTM A-536 Ductile Iron or ASTM A-126 CL. B cast iron.
13. Rating: 200 psig CWP.
14. Conform To: MSS SP-67, MSS SP-25, API-609
15. Operator:
 - a. Valves up to and including 6": Lever-lock operator.

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- b. Valves 8" and larger: Self locking worm gear operator equipped with adjustable stops at open and shut positions.

C. Grooved-End 300 psig butterfly valves:

- 1. NIBCO Model GD 4765
- 2. Other Manufacturers:
 - a. Victaulic
- 3. Upper Stem: ASTM A-582 Type 416 Stainless steel.
- 4. Upper Bearing: Split metal.
- 5. O-Ring: EPDM
- 6. Body: ASTM A-395 ductile iron with polyimide coating.
- 7. Disc: ASTM A-395 ductile iron with EPDM encapsulation.
- 8. Lower Bearing: Split metal.
- 9. Dust Plug: PVC
- 10. Rating: 300 psig CWP.
- 11. Conform To: MSS SP-67
- 12. Operator:
 - a. Valves up to and including 6": Lever-lock operator.
 - b. Valves 8" and larger: Self locking worm gear operator equipped with adjustable stops at open and shut positions.

D. Flanged 200 psig butterfly valves:

- 1. NIBCO Model FC-2765-0
- 2. Upper Stem: ASTM A-582 Type 416 Stainless steel.
- 3. Upper Bushing: TFE over porous bronze, steel backed.
- 4. O-Ring: EPDM
- 5. Body: ASTM A-126 Class B cast iron with polyimide coating.
- 6. Disc: ASTM A-395 ductile iron with EPDM encapsulation.
- 7. Lower Bushing: TFE over porous bronze, steel backed.
- 8. Lower Stem: ASTM A-582 Type 416 Stainless steel.
- 9. Dust Plug: PVC
- 10. Rating: 200 psig CWP.
- 11. Conform To: MSS SP-67 and MSS SP-25
- 12. Operator:
 - a. Valves up to and including 6": Lever-lock operator.
 - b. Valves 8" and larger: Self locking worm gear operator equipped with adjustable stops at open and shut positions.

2.5 BRONZE CHECK VALVES

A. Bronze, Horizontal Swing Check Valves:

- 1. NIBCO Model 413
- 2. Other Manufacturers:
 - a. Milwaukee
 - b. Stockham

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3. Bonnet: ASTM B-62 bronze.
4. Body: ASTM B-62 bronze.
5. Hinge Pin: ASTM B-140 alloy C31400 bronze, or B-134 alloy C23000 bronze.
6. Disc Hanger:
 - a. Sizes ¼" thru ¾": Type 304 stainless steel.
 - b. Sizes 1" and larger: ASTM B-62 bronze.
7. Hanger Nut: ASTM B-16 bronze.
8. Disc Holder: ASTM B-62 bronze.
9. Seat Disc:
 - a. Water and Other Heat Transfer Fluids: ASTM B-62 bronze.
 - b. Steam: TFE
10. Seat Disc Nut: ASTM B-16 or B-62 bronze.
11. Hinge Pin Plug: ASTM B-140 alloy C31600 bronze.
12. Seat Disc Washer (When Provided): ASTM B-98 alloy C65500 or B-103 bronze.
13. Rating: 125 psig SWP and 200 psig CWP.
14. Conform To: MSS SP-80

B. Bronze, Inline Spring Loaded Check Valves:

1. NIBCO Model 480
2. Other Manufacturers:
 - a. Milwaukee
 - b. Stockham
3. Body: ASTM B-584 alloy C84400 bronze.
4. Stem: ASTM A-582 alloy C30300 stainless steel.
5. Disc Holder: 316 Stainless steel
6. Disc:
 - a. Water, Oil, Gas: Buna-N
 - b. Steam: TFE
7. Seat Screw: ASTM A-276 alloy S43000 stainless steel.
8. Body End: ASTM B-584 alloy C84400 bronze.
9. Rating: 125 psig SWP and 250 psig CWP.
10. Conform To: MSS SP-80

2.6 IRON BODY CHECK VALVES

A. Iron Body, Horizontal Swing Check Valves:

1. NIBCO Model 918-B
2. Other Manufacturers:
 - a. Milwaukee
 - b. Stockham
3. Body Bolt: ASTM A-307 steel.
4. Bonnet: ASTM A-126 class B cast iron.
5. Body Gasket: Synthetic Fibers.
6. Body Nut: ASTM A-307 steel
7. Side Plug: ASTM B-16 alloy C36000 Brass.
8. Hanger Pin: ASTM B-16 alloy C36000 Brass.

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9. Hanger: ASTM B-584 alloy C84400 cast bronze.
 10. Disc: ASTM B-584 alloy C84400 cast bronze or ASTM A-536 ductile iron w/bronze face ring.
 11. Seat Ring: ASTM B-584 alloy C84400 cast bronze.
 12. Disc Nut: ASTM B-16 alloy C36000.
 13. Body: ASTM A-126 class B cast iron.
 14. Disc Bolt: ASTM B-16 alloy C36000 Brass.
 15. Disc Plate: ASTM A-126 class B cast iron.
 16. Disc Cage: ASTM A-126 class B cast iron.
 17. Rating: 125 psig SWP and 200 psig CWP.
 18. Conform To: MSS SP-71 Type 1.
- B. Grooved-End, Ductile-Iron Spring Assisted Check Valves: Victaulic Series 716 with EPDM disc seal.
- C. Spring Actuated Silent Check Valves:
1. NIBCO Model F-910
 2. Other Manufacturers:
 - a. Milwaukee
 - b. Stockham
 3. Body: ASTM A48 class 35 cast iron.
 4. Seat: ASTM B-584 alloy C83600 (B) bronze.
 5. Disc: ASTM B-584 alloy C83600 bronze.
 6. Spring: Type 302 ASTM A313 stainless steel.
 7. Bushing:
 - a. 6" and Smaller: ASTM B-16 brass
 - b. 8" and Larger: ASTM B-584 alloy C83600 bronze.
 8. Set Screws: Type 304 ASTM A-276 stainless steel.
 9. Rating: 200 psig CWP.
 10. Conform To: MIL-V-18436F

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 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.

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- 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 chainwheels on operators for ball, butterfly and gate valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.
- F. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Lift Check Valves: With stem upright and plumb.

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. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball or butterfly valves.
 - 2. Throttling Service: Ball or butterfly valves.
 - 3. Pump Discharge: Spring-loaded, lift-disc check valves and ball or butterfly valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
- C. Domestic Water Piping: Use the following types of valves:
 - 1. Valves, NPS 2" and Smaller: Two-Piece, Copper-Alloy Ball Valves (Full Port).
 - 2. Valves, NPS 2-1/2" and 3":
 - a. Two-piece or three-piece, Copper-Alloy Ball Valves (Full Port).
 - b. Wafer-Lug, grooved-end, or flanged butterfly valves.
 - 3. Valves, NPS 4" and Larger: Wafer-Lug, grooved-end, or flanged butterfly valves.
 - 4. Pump Discharge Check Valves (Horizontal or Vertical), NPS 2" and Smaller: Bronze, Inline Lift Check Valves.

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5. Horizontal Check Valves, NPS 2" and Smaller: Bronze, Horizontal Swing Check Valves.
6. Vertical Check Valves, NPS 2" and Smaller: Bronze, Inline Lift Check Valves.
7. Pump Discharge Check Valves (Horizontal or Vertical), NPS 2-1/2" and Larger: Grooved-End, Ductile-Iron Spring Assisted Check Valves or Spring Actuated Silent Check Valves.
8. Horizontal Check Valves, NPS 2-1/2" and Larger: Bronze, Horizontal Swing Check Valves.
9. Vertical Check Valves, NPS 2-1/2" and Larger: Grooved-End, Ductile-Iron Spring Assisted Check Valves or Spring Actuated Silent Check Valves.

3.5 JOINT CONSTRUCTION

- A. Refer to Division 23 Hydronic Piping or pipe, tube, and fitting materials and joining methods.
- B. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

- A. Design Requirement: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer where using methods other than indicated.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test medium.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 - 3. Design seismic-restraint hangers and supports for piping and equipment.

1.4 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:

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1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pre-galvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.
- B. Trapeze Pipe Hanger Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.
 1. Assemble and provide according to manufacturer's written instructions. Center piping on channel to evenly distribute load.
 2. Pipe sizes and numbers shall be in accordance with the following:

TRAPEZE PIPE HANGER TABLE								
PIPE SIZE	4"	3"	2 ½"	2"	1 ½"	1 ¼"	1"	TOTAL # of PIPES
NUMBER OF PIPES PERMITTED IN ONE CHANNEL SUPPORT	2	0	0	0	0	0	0	2
	0	2	2	0	0	0	0	4
	0	2	0	4	0	0	0	6
	0	2	0	0	6	0	0	8
	0	0	4	2	0	0	0	6
	0	0	4	0	2	2	0	8
	0	0	4	0	0	8	0	12
	0	0	0	6	2	2	2	12
	0	0	0	8	0	2	0	10
	0	0	0	0	14	0	0	14
	0	0	0	0	0	16	0	16

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Notes:

1. Piping larger than 4" in diameter is not permitted in a channel support system.
2. Channel support systems shall be limited to eight (8) pipes per channel and two (2) channels (levels) per support system.
3. Smaller pipes can be substituted for larger pipes. For example two ¾" pipes may be installed in lieu of two 1" pipes, or 2" in lieu of 3", etc.
4. Spacing shall be in accordance with requirements for the smallest supported pipe. Refer to other specification sections for spacing requirements. If spacing requirements are not indicated comply with MSS SP-69.

C. Metal Framing Systems:

1. Available Manufacturers:

- a. Anvil International; a subsidiary of Mueller Water Products Inc.
- b. Empire Industries, Inc.
- c. ERICO International Corporation.
- d. Haydon Corporation; H-Strut Division.
- e. NIBCO INC.
- f. PHD Manufacturing, Inc.
- g. PHS Industries, Inc.

2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.

3. Standard: Comply with MFMA-4.

4. Channels: Continuous slotted steel channel with inturred lips.

5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.

6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

7. Coating: Zinc.

2.3 THERMAL-HANGER SHIELD INSERTS

A. Available Manufacturers:

1. Carpenter & Paterson, Inc.
2. Clement Support Services.
3. ERICO International Corporation.
4. National Pipe Hanger Corporation.
5. PHS Industries, Inc.
6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
7. Piping Technology & Products, Inc.
8. Rilco Manufacturing Co., Inc.
9. Value Engineered Products, Inc.

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- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig, ASTM C 552, Type II cellular glass with 100-psig, or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2" beyond sheet metal shield for piping operating below ambient air temperature.

2.4 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
 - 1. Available Manufacturers:
 - a. Cooper B-Line – Dura-Blok
 - b. MAPA Products
 - c. Mifab, Inc. – C-Port
 - d. Miro Industries, Inc.
 - e. OMG, Inc.
 - f. PHP Systems/Design
 - g. Pipe Prop
 - h. Roof Top Blox
 - 2. Provide pipe supports for supporting gas, condensate, refrigeration lines, or hydronic piping on flat roof surfaces. Support shall rest on roof surface without penetrating the roof surface. Supports for condensate piping shall be adjustable vertically to ensure pipe slopes as required.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Curb Mounted Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.5 EQUIPMENT SUPPORTS

- A. Description: Welded, shop or field fabricated equipment support made from structural carbon-steel shapes unless indicated otherwise.

2.6 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

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- 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, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Provide hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69, MSS SP-89, and Table above. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Provide in pipe hanger or shield for insulated piping.
- E. Pipe Stand Installation: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
- F. Provide hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Provide hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Provide lateral bracing with pipe hangers and supports to prevent swaying.
- J. Provide building attachments within concrete slabs or attach to structural steel. Building attachments may not used on steel joists unless otherwise indicated. Provide additional attachments at concentrated loads, including valves, flanges, and strainers, 2-1/2" and larger and at changes in direction of piping. Provide concrete inserts before concrete is placed; fasten inserts to forms and provide reinforcing bars through openings at top of inserts.
- K. Load Distribution: Provide hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Provide hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

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M. Insulated Piping:

1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Provide thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
2. Provide MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
3. Provide MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
4. Shield Dimensions for Pipe: Not less than the following:
 - a. Pipe ¼" to 3-½": 12 inches long and 0.048 inch thick.
 - b. Pipe 4": 12 inches long and 0.06 inch thick.
 - c. Pipe 5" and 6": 18 inches long and 0.06 inch thick.
 - d. Pipe 8" to 14": 24 inches long and 0.075 inch thick.
5. Pipes 8" and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Provide with insulation same thickness as piping insulation.

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 bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 1. Provide 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 so contours of welded surfaces match adjacent contours.

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3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Touchup: Unless otherwise indicated clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Provide 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 a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and immediately apply galvanizing-repair paint. Paint shall comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Provide hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Provide nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Provide copper-plated pipe hangers and copper attachments for copper piping and tubing.
- F. Provide padded hangers for piping that is subject to scratching.
- G. Provide thermal-hanger shield inserts for insulated piping and tubing.
- H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated provide the following:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of stationary pipes 1/2" to 30".
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F pipes 4" to 14", requiring up to 4" of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes 3/4" to 14", requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes 1/2" to 14" if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes 1/2" to 4", to allow off-center closure for hanger installation before pipe erection.

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6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes $\frac{3}{4}$ " to 8".
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes $\frac{1}{2}$ " to 8".
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes $\frac{1}{2}$ " to 8".
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes $\frac{1}{2}$ " to 8".
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes $\frac{1}{2}$ " to 8".
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS $\frac{1}{2}$ " to 3".
12. U-Bolts (MSS Type 24): For support of heavy pipes $\frac{1}{2}$ " to 14".
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes 4" to 14", with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes 4" to 14", with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes 2- $\frac{1}{2}$ " to 14" if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes 1" to 14", from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes 2- $\frac{1}{2}$ " to 14", from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes 2" to 14" if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes 2" to 14" if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes 2" to 14" if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

I. Vertical-Piping Clamps: Unless otherwise indicated provide the following:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers $\frac{3}{4}$ " to 14".
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers $\frac{3}{4}$ " to 14" if longer ends are required for riser clamps.

J. Hanger-Rod Attachments: Unless otherwise indicated provide the following:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

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6. Flat Plate, Double Nut, and Washer as Detailed on Structural Drawings: For attaching to bar joists. Method of attachment to bar joists must be approved by the structural engineer and joist manufacturer.

K. Building Attachments: Unless otherwise indicated provide the following:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Flat Plate, Double Nuts, and Washer as Detailed on Structural Drawings: For use under roof installations with bar-joist construction to attach to bottom chord of joist.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Provide one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

L. Saddles and Shields: Unless otherwise indicated provide the followings:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

M. Spring Hangers and Supports: Unless otherwise indicated provide the following:

1. Restraint-Control Devices (MSS Type 47): To control pipe movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.

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3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- P. Provide powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where indicated in concrete construction.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each identification device type (labels, tags, signs).
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve Schedules: For each piping system to include in maintenance manuals.
- E. 1/16" = 1'-0" scale drawing showing all valve locations to include in maintenance manuals.

1.3 QUALITY ASSURANCE

- A. Wake County Compliance: Comply with Wake County Standards. Refer to Wake County Facilities Design & Construction Guidelines & Standards.
<https://www.wake.gov/departments-government/facilities-design-construction/facilities-design-construction-guidelines-standards>.
- B. 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.
- C. ANSI Compliance: Comply with ANSI Z535 for safety colors and accident prevention signage.

1.4 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 locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, Aluminum, or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having pre-drilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having pre-drilled holes for attachment hardware.

B. Letter Color: White.

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- C. Background Color: Red.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions. Signs will comply with OSHA/ANSI Z535 with pictograms where applicable.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Pre-printed, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Pre-coiled, semi-rigid, plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. 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 high.

2.4 STENCILS

- A. Stencils: Prepared with letter sizes according to Wake County Standards and ASME A13.1 for piping.
 - 1. Stencil Material: Metal or fiberboard.
 - 2. Stencil Paint: Per Wake County Standards. Exterior, gloss, black, unless otherwise indicated. Paint shall be low VOC and shall meet the requirements of section 099100.
 - 3. Identification Paint: Exterior, in colors according to Wake County Standards and ASME A13.1, unless otherwise indicated. Paint shall be low VOC and shall meet the requirements of section 09910.

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2.5 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, numbering scheme approved by Architect. Provide 5/32-inch hole for fastener.
 - 1. Material: 0.032-inch- thick brass or
 - 2. Material: 0.0375-inch- thick stainless steel or
 - 3. Material: 3/32-inch- thick laminated plastic with 2 black surfaces and white inner layer.
- B. Valve-Tag Fasteners: Brass wire-link or beaded chain; or S-hook.

2.6 VALVE SCHEDULES

- A. Valve Schedules: For each piping system, on standard-size bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws and hangers.
 - 2. Frame: Finished hardwood or extruded aluminum.
 - 3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.7 VALVE PLAN

- A. Valve Plan: Prepare a scale drawing. Provide the location and identity of each valve.
 - 1. Valve Plan Frames: Glazed display frame for removable mounting on masonry walls for each page of valve plan. Include mounting screws and hangers.
 - 2. Frame: Finished hardwood or extruded aluminum.
 - 3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.8 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: 3 by 5-1/4 inches minimum.
 - 2. Fasteners: Brass grommet and wire.

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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 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 and permanently fasten equipment nameplates on each major item of plumbing equipment that does not have nameplate or has a nameplate that is damaged or located where not easily visible. Locate nameplates where easily visible. Include nameplates for all plumbing equipment:
- B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
 1. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
 - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - b. Meters, gages, and thermometers.
 - c. Fuel-burning units.
 - d. Pumps, compressors, and other motor-driven equipment.
 - e. Heat exchangers and similar equipment.
 - f. Water heaters and storage tanks.
- C. Install equipment signs with screws or permanent adhesive on or near each major item of plumbing/mechanical equipment. Locate signs where easily visible.
 1. Identify plumbing/mechanical equipment with equipment markers following Wake County color codes.

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2. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
- D. Install access panel markers with screws on equipment access panels.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping per Wake County Standards.
- B. Stenciled Pipe Label Option: Stenciled labels may be preferred by Wake County Standards, provided instead of manufactured pipe labels, at owner's option. Install stenciled pipe labels with painted, color-coded bands or rectangles on each piping system.
1. Identification Paint: Use for contrasting background.
 2. Stencil Paint: Use for pipe marking.
- C. 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. 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 inaccessible 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 along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- D. Pipe System and Pipe Label Color Schedule:
1. Domestic Cold Water Piping:
 - a. Wording: DOMESTIC COLD WATER
 - b. Letter Color: White.
 - c. Background Color: Green.
 - d. Pipe/Covering Color: Blue.
 2. Domestic Hot Water Piping:
 - a. Wording: DOMESTIC HOT WATER
 - b. Letter Color: Black.

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- c. Background Color: Yellow.
 - d. Pipe/Covering Color: Light Red.
- 3. Domestic Hot Water Return Piping:
 - a. Wording: DOMESTIC HOT WATER RETURN
 - b. Letter Color: Black.
 - c. Background Color: Yellow.
 - d. Pipe/Covering Color: Orange.
- 4. Domestic Make-Up Water Piping:
 - a. Wording: MAKE-UP WATER
 - b. Letter Color: White.
 - c. Background Color: Green.
 - d. Pipe/Covering Color: Blue.
- 5. Make-Up Water Non-Potable Piping:
 - a. Wording: NON-POTABLE MAKE-UP WATER
 - b. Letter Color: Black.
 - c. Background Color: Yellow.
 - d. Pipe/Covering Color: Purple.
- 6. Tempered Water Piping:
 - a. Wording: TEMPERED WATER
 - b. Letter Color: White.
 - c. Background Color: Green.
 - d. Pipe/Covering Color: Light Blue.
- 7. Sanitary Piping:
 - a. Wording: SANITARY DRAIN
 - b. Letter Color: White.
 - c. Background Color: Green.
 - d. Pipe/Covering Color: * Pipe not painted unless exposed. Verify color selection with Wake County.
- 8. Storm Piping:
 - a. Wording: STORM DRAIN
 - b. Letter Color: White.
 - c. Background Color: Green.
 - d. Pipe/Covering Color: * Pipe not painted unless exposed. Verify color selection with Wake County.
- 9. Plumbing Vent Piping:
 - a. Wording: VENT
 - b. Letter Color: White.

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- c. Background Color: Green.
- d. Pipe/Covering Color: * Pipe not painted unless exposed. Verify color selection with Wake County.

10. Natural Gas Piping:

- a. Wording: NATURAL GAS
- b. Letter Color: Black.
- c. Background Color: Yellow.
- d. Pipe/Covering Color: Yellow.

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following:
 - 1. Valve-Tag Size and Shape:
 - a. Domestic Cold Water: 1 ½", round.
 - b. Domestic Hot Water: 1 ½", round.
 - c. Domestic Hot Water Recirculation: 1 ½", round.
 - d. Natural Gas: 2", round.
 - 2. Valve-Tag Color:
 - a. Domestic Cold Water: Blue.
 - b. Domestic Hot Water: Red.
 - c. Domestic Hot Water Recirculation: Red.
 - d. Natural Gas: Yellow.
 - 3. Letter Color:
 - a. Domestic Cold Water: Black.
 - b. Domestic Hot Water: White.
 - c. Domestic Hot Water Recirculation: White.
 - d. Natural Gas: 2", Black.

3.5 VALVE SCHEDULE INSTALLATION

- A. Mount valve schedules on wall in accessible location in each major equipment room and where directed by owner.

3.6 VALVE PLAN INSTALLATION

- A. Mount valve plans on wall in accessible location in each major equipment room and where directed by owner.

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3.7 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

3.8 ADJUSTING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.9 CLEANING

- A. Clean faces of mechanical identification devices and glass fronts of valve schedules and plans.

END OF SECTION 220553

SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

- A. Outdoor pipe: Pipe located outside the building insulation envelope.
- B. Plenum: An unoccupied space or void, on the conditioned side of the building insulation and vapor barrier, being used to return conditioned air to the inlet side of a return or exhaust fan either directly or via a duct connection. An example would be a space with air handling light fixtures or openings in the ceiling used to transport air through the ceiling and then to an open duct located above the ceiling in another location.
- C. Indirectly Conditioned Space: A space having no direct conditioning but, due to air movement induced by an exhaust, or return opening, is conditioned by makeup air from an adjacent space. An example would be a small toilet. Boiler rooms, fan rooms, and mechanical rooms do not qualify as indirectly conditioned spaces.
- D. Inside the Building Insulation Envelope: For the purposes of this section, boiler rooms, fan rooms, and mechanical rooms are considered to be OUTSIDE the building insulation envelope.
- E. Exposed: Visible from any angle without removal of building element or equipment.
- F. Concealed: Enclosed in building element or above ceiling such that it is not visible from any angle without removal of building element or equipment.

1.3 SUBMITTALS

- A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for the following:
 - 1. Detail application of removable insulation covers.
 - 2. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 3. Detail attachment and covering of heat tracing inside insulation.
 - 4. Detail insulation application at pipe expansion joints for each type of insulation.
 - 5. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 6. Detail removable insulation at piping specialties, equipment connections, and access panels.
 - 7. Detail application of field-applied jackets.
 - 8. Detail application at linkages of control devices.
 - 9. Detail field application for each equipment type.

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1.4 QUALITY ASSURANCE

- A. Wake County Compliance: Comply with Wake County Standards. Refer to Wake County Facilities Design & Construction Guidelines & Standards.
<https://www.wake.gov/departments-government/facilities-design-construction/facilities-design-construction-guidelines-standards>.
- 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.
- C. Mock-Up
 - 1. Provide a mockup of piping insulation assembly, minimum 10 feet in length, including insulation, vapor barrier, canvas jacketing, adhesives, accessories, system labeling, and identification.
 - 2. Location: As directed by Owner/Architect/Engineer.
 - 3. Demonstrate quality of insulation fit, joint treatment, and jacketing application.
 - 4. Approved mockup may remain in place as part of the Work if undisturbed and accepted.
 - 5. Do not proceed with remaining Work until mockup is reviewed and accepted by Owner/Architect/Engineer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Ship insulation materials in containers marked by manufacturer with type, grade, and maximum use temperature.
- B. Ship Insulated Piping System Components on pallets and wood supports. Securely fasten and protect from damage. Store off the ground and cover with opaque waterproof tarp to protect materials from sunlight and rain.

1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Section "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping installer for piping insulation, duct installer for duct insulation, and equipment installer for equipment insulation.
- C. Maintain clearances required for maintenance.
- D. Coordinate installation and testing of heat tracing.

PART 2 - PRODUCTS

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2.1 MANUFACTURERS

A. Available Manufacturers:

1. Mineral-Fiber Insulation:
 - a. CertainTeed Manson.
 - b. Johns Manville
 - c. Knauf FiberGlass GmbH.
 - d. Owens-Corning Fiberglas Corp.
 - e. Schuller International, Inc.
2. Flexible Elastomeric Thermal Insulation:
 - a. Armstrong World Industries, Inc.
 - b. Rubatex Corp.
3. Polyolefin Insulation:
 - a. Armstrong World Industries, Inc.
 - b. IMCOA.
4. Closed-Cell Phenolic-Foam Insulation:
 - a. Kooltherm Insulation Products, Ltd.
5. Removable Insulation Covers:
 - a. Advance Thermal Corp.

2.2 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 Board: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB, with factory applied FSK Jacket. Meet the requirements of ASTM C 1290, Type III, inorganic glass fibers bonded by a thermosetting resin to maximum service temperature of 250°F. Faced insulation shall not exceed 25 Flame Spread, 50 Smoke Developed when tested in accordance with ASTM E84.
- G. Semi-Rigid Mineral-Fiber Board: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 1136, Type I, II, III, & IV with factory applied all-service jacket (ASJ) or Type II, IV with factory applied Foil Scrim Kraft (FSK) jacket.
- H. Mineral-Fiber Blanket with Factory Applied FSK Jacket: Meet the requirements of ASTM C 1290, Type III, inorganic glass fibers bonded by a thermosetting resin with a multi-purpose foil-scrim kraft (FSK) jacket to maximum service temperature of 250°F. FSK shall meet the requirements of ASTM C 1136, Type II, when surface burning characteristics are determined in

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accordance with ASTM E 84 with the foil surface of the material exposed to the flame as it is in the final composite. Composite (insulation, facing and adhesive) shall not exceed 25 Flame Spread, 50 Smoke Developed when tested in accordance with ASTM E 84. Insulation properties shall be as follows:

1. Thickness: 1-1/2"
 - a. Density: 0.75 pcf
 - b. Minimum uncompressed R value: 5.0
 - c. Minimum installed R value assuming 25% compression: 4.0
2. Thickness: 2"
 - a. Density: 1.0 pcf
 - b. Minimum uncompressed R value: 7.4
 - c. Minimum installed R value assuming 25% compression: 6.0
3. Alternate to 2" 1.0 pcf: Thickness: 2.2"
 - a. Density: 0.75 pcf
 - b. Minimum uncompressed R value: 7.4
 - c. Minimum installed R value assuming 25% compression: 6.0
4. Thickness: 3"
 - a. Density: 0.75 pcf
 - b. Minimum uncompressed R value: 10.0
 - c. Minimum installed R value assuming 25% compression: 8.3
- I. Medium Temperature Mineral-Fiber Blanket for Operating Temperatures from 250 to 850 deg F: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II, without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.
- J. High Temperature Mineral-Fiber Blanket for Temperatures above 850 deg F: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.
- K. Mineral-Fiber Pipe Insulation: Glass fibers bonded with a thermosetting resin complying with the following:
 1. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket.
 2. Semi-Rigid Mineral-Fiber Board: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 1136, Type I, II, III, IV with factory applied all-service jacket (ASJ) or Type II, IV with factory applied Foil Scrim Kraft (FSK) jacket.
 3. Blanket Insulation: Comply with ASTM C 553, Type II, without facing.
 4. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
 5. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C 196.
 6. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
- L. 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. Adhesive: As recommended by insulation material manufacturer.

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2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.

- M. Closed-Cell Phenolic-Foam: Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.
- N. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

2.3 FIELD-APPLIED JACKETS

- A. General: ASTM C 921, Type 1, unless otherwise indicated.
- B. Canvas Cloth: Cotton canvas, plain-weave, minimum 8 ounces per square yard.
1. Treatment: Fire-retardant and mildew-resistant finish.
 2. Color: refer to labeling and identification spec for system color and finish requirements.
- C. Glass Cloth: Woven glass-fiber fabric, plain-weave, minimum 8 ounces per square yard.
- D. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.
- E. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils thick; roll stock ready for shop or field cutting and forming.
1. Adhesive: As recommended by insulation material manufacturer.
 2. PVC Duct Jacket Color: White or gray.
 3. PVC Pipe Jacket Color: Color-code piping jackets based on materials contained within the piping system.
- F. Aluminum Jacket: Deep corrugated sheets manufactured from aluminum alloy complying with ASTM B 209, and having an integrally bonded moisture barrier over entire surface in contact with insulation. Factory cut and rolled to indicated sizes. Comply with ASTM B 209, 3003 alloy, H-14 temper.
1. Finish and Thickness: Stucco-embossed finish, 0.016 inch thick.
 2. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and kraft paper.
 3. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, finish, and thickness as jacket.
- G. Stainless-Steel Jacket: Deep corrugated sheets of stainless steel complying with ASTM A 666, Type 304 or 316; 0.10 inch thick; and roll stock ready for shop or field cutting and forming to indicated sizes.
1. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and kraft paper.
 2. Elbows: Gore type, for 45- and 90-degree elbows in same material, finish, and thickness as jacket.
 3. Jacket Bands: Stainless steel, Type 304, 3/4 inch wide.
- H. Heavy PVC Pipe Fitting Covers: Factory-fabricated fitting covers manufactured from 30-mil-thick, high-impact, ultraviolet-resistant PVC.
1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
 2. Adhesive: As recommended by insulation material manufacturer.

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- I. Standard PVC Pipe Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil- thick, high-impact, ultraviolet-resistant PVC.
 - 1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
 - 2. Adhesive: As recommended by insulation material manufacturer.

2.4 REMOVABLE INSULATION COVERS

- A. Pre-manufactured easily removable insulation cover/blanket intended for insulation of equipment and devices requiring periodic maintenance.

2.5 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, pre-sized a minimum of 8 oz. /sq. yd.
 - 1. Tape Width: 4 inches.
- B. Bands: 3/4 inch wide, in one of the following materials compatible with jacket:
 - 1. Stainless Steel: ASTM A 666, Type 304; 0.020 inch thick.
 - 2. Galvanized Steel: 0.005 inch thick.
 - 3. Aluminum: 0.007 inch thick.
 - 4. Brass: 0.010 inch thick.
 - 5. Nickel-Copper Alloy: 0.005 inch thick.
- C. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel.
- D. Weld-Attached Anchor Pins and Washers: Copper-coated steel pin for capacitor-discharge welding and galvanized speed washer. Pin length sufficient for insulation thickness indicated.
 - 1. Welded Pin Holding Capacity: 100 lb for direct pull perpendicular to the attached surface.
- E. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct, pipe, plenum and breeching with adhesive. Pin length sufficient for insulation thickness indicated.
 - 1. Adhesive: Recommended by the anchor pin manufacturer as appropriate for surface temperatures of ducts, pipes, plenums, and breechings; and to achieve a holding capacity of 100 lb. for direct pull perpendicular to the adhered surface.
- F. Self-Adhesive Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct, pipe, and plenum with adhesive. Pin length sufficient for insulation thickness indicated.
- G. All adhesives/mastics shall be compatible with insulation and jacketing materials.

2.6 VAPOR RETARDERS

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

2.7 REMOVABLE INSULATION COVERS

- A. Pre-manufactured easily removable insulation cover/blanket intended for insulation of equipment and devices requiring periodic maintenance.

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.
- B. 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.

3.3 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of piping, and fittings.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thickness required for each system.
- C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Apply multiple layers of insulation with seams staggered.
- E. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- F. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- G. Keep insulation materials dry at all times. Insulation that becomes wet or is otherwise damaged beyond repair shall be removed immediately and replaced. Replacement material and installation shall be in accordance with these specifications.
- H. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- I. Apply insulation with the minimum number of joints practical.
- J. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
- K. Refer to special instructions for applying insulation over fittings, valves, and specialties.
- L. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
 - 1. Apply insulation continuously through hangers and around anchor attachments.

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2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
 3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.
- M. Insulation Terminations: For insulation application where vapor retarders are indicated, seal ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- N. Apply insulation with integral jackets as follows:
1. Pull jacket tight and smooth.
 2. Joints and Seams: Cover with tape and vapor retarder as recommended by insulation material manufacturer to maintain vapor seal.
 3. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to pipe joints and fittings.
- O. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.
- P. Install vapor-retarder mastic on pipes and equipment.
1. Pipes and equipment with vapor retarders: Overlap insulation facing at seams and seal with vapor-retarder mastic and pressure-sensitive tape having same facing as insulation. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-retarder seal.
 2. Pipes and equipment without vapor retarders: Overlap insulation facing at seams and secure with outward clinching staples and pressure-sensitive tape having same facing as insulation.
- Q. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
1. Seal penetrations with vapor-retarder mastic.
 2. Apply insulation for exterior applications tightly joined to interior insulation ends.
 3. Seal insulation to roof flashing with vapor-retarder mastic.
- R. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.
- S. Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire/smoke damper sleeves for fire-rated wall and partition penetrations.
- T. Floor Penetrations: Terminate insulation at underside of floor assembly and at floor support at top of floor.
1. For insulation indicated to have vapor retarders, taper termination and seal insulation ends with vapor-retarder mastic.

3.4 MINERAL-FIBER INSULATION APPLICATION

- A. Blanket Applications for Pipes: Secure blanket insulation with adhesive, and anchor pins with speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of pipe surfaces.
 2. Apply adhesive to entire circumference of pipes and to all surfaces of fittings and transitions.
 3. Install anchor pins and speed washers on sides, top, and bottom of horizontal pipes.
 4. Impale insulation over anchors and attach speed washers.
 5. Cut excess portion of pins extending beyond speed washers. Cover exposed pins and washers with tape matching insulation facing.
 6. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch staples, 1-inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
 7. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. Secure with steel band at end joints and spaced a maximum of 18 inches o.c.
 8. Apply insulation on pipe fittings and transitions with a full insulation segment for each surface. Apply insulation on pipe elbows with individually mitered gores cut to fit the elbow.
 9. Insulate pipe hangers and flanges that protrude beyond the insulation surface with 6-inch-wide strips of the same material as insulation. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.
 10. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.
- B. Board Applications for Equipment: Secure board insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of duct, plenum, & equipment surfaces.
 2. Apply adhesive to all surfaces of fittings and equipment.
 3. Cut excess portion of pins extending beyond speed washers. Cover exposed pins and washers with tape matching insulation facing.
 4. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch staples, 1-inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
 5. Insulate equipment stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6" wide strips of the insulating material. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.
 6. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

3.5 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

- A. Apply insulation to ducts, plenums, and equipment as follows:
1. Follow the manufacturer's written instructions for applying insulation.

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2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the duct, plenum, and equipment surface.

3.6 CLOSED-CELL PHENOLIC-FOAM INSULATION APPLICATION

A. Apply insulation as follows:

1. Secure each layer of insulation with stainless-steel bands at 12-inch intervals and tighten without deforming the insulation materials.
2. Apply two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch, soft-annealed, stainless steel wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
3. On exposed applications, finish insulation with a skim coat of mineral-fiber, hydraulic-setting cement to surface of installed insulation. When dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin the finish coat to achieve smooth finish.

3.7 FIELD-APPLIED JACKET APPLICATION

A. Apply cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.

1. Apply jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed cloth between two 0.062-inch- thick coats of jacket manufacturer's recommended adhesive.
3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.

3.8 FINISHES

- A. Cloth Jacketed Insulation: Paint insulation finished with cloth jacket as indicated.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color shall be as indicated in Wake County Standards. Vary first and second coats to allow visual inspection of the completed Work.

3.9 APPLICATIONS

A. Insulation materials and thickness are specified at the end of this Section.

B. Insulate all pipe and equipment:

1. Insulate pipe in accordance with the application schedule(s) below.
2. Exceptions: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
 - a. Vibration-control devices.
 - b. Testing agency labels and stamps.
 - c. Nameplates and data plates.
 - d. Manholes.
 - e. Handholes.
 - f. Cleanouts.
 - g. Plastic Condensate Drain piping.

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- h. Factory-insulated equipment.
- i. Flexible connectors.

3.10 INDOOR APPLICATION SCHEDULE (ABOVE GRADE):

A. Service: Domestic cold-water, hot-water, tepid-water, and circulated water.

1. Insulation Material: Mineral fiber preformed pipe insulation with FSK or ASJ. Provide outer canvas jacketing and color finish matching Wake County Standards.
2. Insulation Thickness: Apply the following insulation thicknesses:
 - a. 40°F – 60°F Systems
 - 1) Less than 1" in diameter: ½"
 - 2) 1" through 1¼" in diameter: ½"
 - 3) 1½" through 3" in diameter: 1"
 - 4) 3" through 6" in diameter: 1"
 - 5) 8" in diameter: 1"
 - b. 61°F – 140°F Systems
 - 1) Less than 1" in diameter: 1"
 - 2) 1" through 1¼" in diameter: 1"
 - 3) 1½" through 3" in diameter: 1½"
 - 4) 3" through 6" in diameter: 1½"
 - 5) 8" in diameter: 1½"
 - c. 141°F – 200°F Systems
 - 1) Less than 1" in diameter: 1½"
 - 2) 1" through 1¼" in diameter: 1½"
 - 3) 1½" through 3" in diameter: 2"
 - 4) 3" through 6" in diameter: 2"
 - 5) 8" in diameter: 2"
3. Vapor Retarder Required: Yes, for domestic cold-water systems; No, for domestic hot-water systems.
4. Finish: Painted per Wake County Standards.
 - a. Refer to 220553 Identification for Plumbing Piping and Equipment

B. Service: Rainwater conductors (Including secondary roof drain conductors). Insulate first thirty linear feet of piping including vertical piping from drain body and first horizontal piping run. If a second vertical run occurs before thirty linear feet is reached, terminate insulation at end of first horizontal run.

1. Insulation Material: Mineral fiber preformed pipe insulation with FSK or ASJ. Provide outer canvas jacketing and color finish matching Wake County Standards.
2. Insulation Thickness: 1"
3. Vapor Retarder Required: Yes.
4. Finish: Painted per Wake County Standards.
 - a. Refer to 220553 Identification for Plumbing Piping and Equipment

C. Service: Roof drain and overflow drain bodies.

1. Insulation Material: Semi-Rigid Mineral-Fiber Board Thermal Insulation

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2. Insulation Thickness: 1½"
3. Vapor Retarder Required: Yes.
4. Finish: Painted per Wake County Standards.
 - a. Refer to 220553 Identification for Plumbing Piping and Equipment

D. Service: Exposed piping:

1. Insulation Material: Mineral fiber preformed pipe insulation with FSK or ASJ. Provide outer canvas jacketing and color finish matching Wake County Standards.
2. Insulation Thickness: 1"
3. Vapor Retarder Required: Yes.
4. Finish: Painted per Wake County Standards.
 - a. Refer to 220553 Identification for Plumbing Piping and Equipment

E. Service: Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Drainage from any Equipment. Measurement shall be pipe length.

1. Insulation Material: Mineral fiber preformed pipe insulation with FSK or ASJ. Provide outer canvas jacketing and color finish matching Wake County Standards.
2. Insulation Thickness: 1"
3. Vapor Retarder Required: Yes.
4. Finish: Painted per Wake County Standards.
 - a. Refer to 220553 Identification for Plumbing Piping and Equipment

3.11 INDOOR APPLICATION SCHEDULE (BELOW GRADE):

1. None required.

END OF SECTION 220700

SECTION 220813 - COMMISSIONING OF PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. The purpose of this section is to specify the Division 22 contractor responsibilities in the commissioning (Cx) process.
- B. Commissioning requires the participation of the Division 22 contractor to ensure that all systems are operating in a manner consistent with the Contract Documents. The general commissioning requirements and coordination are detailed in Section 019113, General Commissioning Requirements. The Division 22 contractor shall be familiar with all parts of Section 019113 and the Cx Plan issued by the Commissioning Authority (CxA) and shall execute all commissioning responsibilities assigned to them in the Contract Documents.
- C. Section includes Cx process requirements for the following plumbing systems, assemblies, and equipment:
 - 1. Gas-fired hot water heaters
 - 2. Recirculation pumps

1.3 RESPONSIBILITIES

- A. The responsibilities of various parties in the commissioning process, as specifically related to the plumbing systems, are provided in this section.
- B. Refer to Section 019113 and the Cx Plan for all typical commissioning process requirements for each team member.
- C. Each Contractor and subcontractor shall review this Section and shall include in their bids cost for carrying out the work described, as it applies to each Division and Section of these specifications, individually and collectively.
- D. The commissioning responsibilities applicable to the contractors of Division 22 are as follows (all references apply to commissioned equipment only):

Construction and Acceptance Phases

- 1. Include the cost of commissioning work in the contract price.

2. Attend a commissioning kick-off meeting and other necessary meetings scheduled by the CxA to facilitate the Cx process, as indicated in specification section 019113.
3. Contractors shall provide the CxA with cut sheets and shop drawing submittals of commissioned equipment to the CxA.
4. Provide additional requested documentation, prior to normal O&M manual submittals, to the CxA for development of Pre-Functional Checklists (PFC) and Functional Performance Testing (FPT) procedures.
 - a. Typically, this will include detailed manufacturer installation and startup, operating, troubleshooting and maintenance procedures, full details of any owner-contracted tests, fan and pump curves, full factory testing reports, if any, and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation and checkout materials that are 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.
 - b. The CxA may request further documentation necessary for the commissioning process.
5. Provide a copy of the equipment submittals of commissioned equipment, through normal channels, to the CxA for review and comment.
6. Contractors shall assist (along with the design engineers) 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.
7. Provide assistance to the CxA in preparation of the specific FPT procedures listed in the Cx Plan (prepared by the CxA), Section 019113 and this section. Contractor shall review test procedures to ensure feasibility, safety and equipment protection.
8. Develop a full startup and initial checkout plan using manufacturer's startup procedures and PFC from the CxA. Submit manufacturer's detailed startup procedures and the full startup plan and procedures and other requested equipment documentation to CxA for review and comment.
9. During the startup and initial checkout process, execute and document the plumbing-related portions of the PFCs provided by the CxA in the online commissioning portal, CxAlloy, for all commissioned equipment.
10. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the CxA.
11. Address current A/E punch list items before functional testing.
12. Provide skilled technicians to execute starting of equipment and to execute the FPTs. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.
13. Perform FPT under the direction of the CxA for specified equipment in the Cx Plan, this Section and Section 019113. Assist the CxA in interpreting the monitoring data, as necessary.
14. Correct deficiencies (differences between specified and observed performance) as interpreted by the CxA, OR and A/E and retest the equipment.
15. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.
16. During construction, maintain hard copy and CAD as-built red-line drawings for all drawings and provide final record drawings for all owner and contractor-generated coordination drawings. Update after completion of commissioning (excluding deferred testing).

17. Provide training of the Owner's operating personnel as specified.
18. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

Warranty Period

1. Execute seasonal or deferred functional performance testing, witnessed by the CxA, according to the specifications.
2. Correct deficiencies and make necessary adjustments to O&M manuals and record drawings for applicable issues identified in any seasonal testing.
3. Participate in the near-warranty end (ten month) post occupancy visit.

1.4 RELATED WORK

- A. Refer to Section 019113 for a listing of all sections where commissioning requirements are found.
- B. Refer to Section 019113 for all systems to be commissioned.

1.5 SUBMITTALS

- A. Division 22 shall provide submittal documentation relative to commissioning to the CxA as requested by the CxA. Refer to Section 019113 for additional Division 22 requirements.

1.6 WEB-BASED COMMISSIONING PORTAL

- A. All general and major contractors participating in the Cx process shall use the web-based Cx Portal, CxAlloy ("Portal" or "CxAlloy") to document the Cx procedures. The Portal is a Web-based Internet hub used to electronically collaborate and coordinate activities and deliverables throughout the Cx process. The Portal is hosted by the CxA and shall be accessible to all Parties participating in the Cx program. The Portal provides a common location to store PFCs, Startup Documentation, FPTs and results, Issues Log tracking, project documents and deliverables. It also serves as a collaborative e-mail hub to facilitate, automate, and track communications between Parties relating to the Cx process.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. The Division 22 contractor shall provide all test equipment necessary to fulfill the testing requirements of this Division.
- B. Refer to Section 019113 for additional Division 22 test equipment requirements.
- C. Proprietary test equipment required by the manufacturer, whether specified or not, shall be provided by the manufacturer of the equipment through the contractor. The manufacturer shall provide the test equipment, demonstrate its use and assist the CxA in the Cx process.

2.2 INCIDENTAL EQUIPMENT

- A. The Division 22 contractor shall provide all scaffolds, staging, ladders and accessories required to allow testing agencies, consultants and Owner's staff safe access to equipment, valves and other devices located above floor level.

PART 3 - EXECUTION

3.1 MEETINGS

- A. Refer to Section 019113 for additional meeting requirements.
- B. Participation at various commissioning meetings shall depend on the purpose of the meeting and may consist of, but not be limited to, the following members of the project commissioning team: the Owner's representative (i.e. project manager and/or facility staff), the CxA, the Construction Manager (CM) or General Contractor (GC), subcontractors and/or manufacturer's technical representative as required, the architect/engineer (A/E), and any specialists deemed appropriate by the Cx team.
- C. All the listed Cx team members shall participate in the Cx kick-off meeting.
- D. Participate, as applicable, in Cx coordination meetings in accordance with related Section 019113.
- E. Participate, as needed, in deficiency resolution meetings.

3.2 STARTUP

- A. The plumbing contractor shall follow the startup, initial checkout procedures, and PFCs for the equipment and systems listed in the Summary in this section and Section 019113. The Division 22 contractor has startup responsibility and is required to complete systems and sub-systems, so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility to the CxA or Owner.
- B. FPT is intended to begin upon completion of a system. FPT will not proceed prior to the completion of systems, or sub-systems, which includes completion of the PFCs and completion and approval of any necessary testing, adjusting and balancing (TAB) requirements.

3.3 PRE-FUNCTIONAL CHECKLISTS

- A. Sampling Strategy: 100% of commissioned systems and equipment shall have PFCs completed and submitted for review and approval prior to FPT. The CxA may observe the Division 22 contractor's completion of the PFCs.
- B. Typical aspects of plumbing PFCs verify that the equipment matches the approved submittal, is installed properly, is started-up (and startup is documented) and integrated disciplines (i.e.

electrical, equipment vendors, controls) have completed their work required for the equipment and system to function in its entirety. Examples would include spot checking of wiring/termination point-to-points and verification of alarm point parameters and messages.

3.4 CALIBRATION

- A. Sensor and actuator calibration and calibration methods are covered in Section 019113 and other Division 22 Sections and are the responsibility of the Division 22 contractor.

3.5 TESTING PREPARATION

- A. Inspect and verify the position of each device and interlock identified on checklists.
- B. Certify that plumbing systems, subsystems, and equipment have been installed, calibrated, started, quality control tested and code tested (as applicable) and are operating according to the Contract Documents.
- C. Certify that plumbing instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest setpoints have been recorded.
- D. Certify that TAB procedures have been completed and that TAB reports have been submitted, discrepancies corrected, and corrective work approved by the Engineer of Record.
- E. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.6 FUNCTIONAL PERFORMANCE TESTS

- A. FPT is intended to begin upon completion of a system, including startup and completion of the PFCs. Functional testing may proceed prior to the completion of systems or sub-systems at the discretion of the CxA and Owner. Beginning system testing before full completion does not relieve the Contractor from fully completing the system, including all PFCs as soon as possible.
- B. Refer to Section 019113 for a complete list of systems to be commissioned and a description of the process.
- C. Sampling Strategy:
 - 1. Gas-fired hot water heaters (100%)
 - 2. Recirculation pumps (100%)
- D. Refer to Section 019113, Sampling for the Sampling/Failure Rule.
- E. Typical aspects of plumbing FPTs verify that systems, subsystems and equipment function interactively and throughout the full range of operating conditions (e.g. low load, design load, component failures, alarm conditions, safety interlocks including with life safety systems, etc.)

and modes (e.g. normal shutdown, normal auto position, normal manual position, power failure including control power, emergency power, unoccupied, fire alarm, 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. Positive confirmation of state/status shall be shown both locally and via the BAS, as specified in the Contract Documents.

- F. Development of Test Procedures: Before test procedures are written, the CxA shall obtain project contract documentation and a current list of change orders and RFI's affecting equipment or systems, including an updated points list, program code, control sequences and parameters and electrical coordination study. The CxA shall develop specific test procedures and forms for evaluating performance of all integral components and their functioning as a complete unit within design requirements and manufacturer's published data. Prior to execution, the CxA shall provide a copy of the test procedures to the Contractors who shall review the tests for feasibility, safety, equipment and warranty protection.

3.7 TESTING DOCUMENTATION, NON-CONFORMANCE AND APPROVALS

- A. Refer to Section 019113 for specific details on non-conformance issues relating to PFCs and tests.
- B. Refer to Section 019113 for issues relating to functional performance tests.

3.8 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. The following O&M manual requirements do not replace O&M manual documentation requirements elsewhere in these specifications.
- B. Division 22 contractor shall compile and prepare documentation for all equipment and systems covered in Division 22 and deliver to the CM/GC for inclusion in the O&M manuals.
- C. The CxA shall receive a copy of the O&M manuals for concurrent review and comment with the A/E.

3.9 TRAINING OF OWNER PERSONNEL

- A. The CM/GC shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed in accordance with Division 1 requirements. Refer to Section 019113 for additional details.
- B. The CxA shall be responsible for overseeing and approving the content and adequacy of the training of Owner personnel for commissioned equipment. Refer to Section 019113 for additional details.
- C. The Division 22 contractor shall have the following training responsibilities:
 - 1. Provide the CxA with a training plan a minimum of eight (8) weeks before the planned training according to the outline described in Section 019113.

2. Provide designated Owner personnel with comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of commissioned plumbing equipment or system.
3. Training shall start with classroom sessions, if necessary, followed by hands on training on each piece of equipment.
4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the startup technician for the piece of equipment, the installing contractor or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation for the specific piece of equipment are required. More than one party may be required to execute the training.
6. The training sessions shall follow the outline in the Table of Contents of the O&M manual and illustrate whenever possible the use of the O&M manuals for reference.
7. Training shall include:
 - a. Use the printed installation, operation and maintenance instruction material included in the O&M manuals.
 - b. Include a review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include startup, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.
 - c. Discuss relevant health and safety issues and concerns.
 - d. Discuss warranties and guarantees.
 - e. Cover common troubleshooting problems and solutions.
 - f. Explain information included in the O&M manuals and the location of all plans and manuals in the facility.
 - g. Discuss any peculiarities of equipment installation or operation.
8. Hands-on training shall include startup, operation in all modes possible, including manual, shutdown and any emergency procedures and preventative maintenance of all pieces of equipment.
9. The Division 22 contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not controlled by the BAS.
10. Training shall occur after functional testing is complete, unless approved otherwise by the Owner's Representative and CxA.

3.10 WRITTEN WORK PRODUCTS

- A. Written work products of Contractors will consist of the startup and initial checkout plan described in Section 019113 and the completed startup, initial checkout and PFCs.

END OF SECTION 220813

SECTION 221113 – FACILITY NATURAL-GAS PIPING

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, 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.

1.3 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
 - 1. Piping and Valves: 100 psig minimum unless otherwise indicated.
 - 2. Service Regulators: 65 psig minimum unless otherwise indicated.
 - 3. Service Meter: 65 psig minimum unless otherwise indicated.
- B. Gas System Pressures: Primary pressure from the utility is more than 2.0 psig, and is reduced to a secondary pressure of 2.0 psig by a pressure reducing valve installed immediately downstream of the meter, and is reduced again by pressure reducing valves located at each piece of equipment.

1.4 SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Piping specialties.
 - 2. Pipe and fittings.
 - 3. Corrugated, stainless-steel tubing with associated components.
 - 4. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
 - 5. Pressure regulators. Indicate pressure ratings and capacities.
 - 6. Service meters. Indicate pressure ratings and capacities. Include bypass fittings bypass fittings and meter bars meter bars.
 - 7. Dielectric fittings.

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- B. Operation and Maintenance Data: For motorized gas valves, pressure regulators, and service meters to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components and Devices: If indicated, provide electrical components and devices that are listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Applicable Codes: Comply with the 2021 South Carolina Fuel Gas Code.
- C. Fuel Gas Piping: Listed and labeled as required by the 2021 South Carolina Fuel Gas Code.
- D. UL Standard: Provide components listed in UL's "Gas and Oil Equipment Directory" where UL listing is indicated.
- E. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- F. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and dispose of liquids from natural-gas piping according to requirements of authorities having jurisdiction.
- B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.
- D. Protect stored PE pipes and valves from direct sunlight.

1.7 PROJECT CONDITIONS

- A. Perform site survey: Contract with utility-locating service for area where Project is located, and locate utilities.
- B. Design values of fuel gas supplied for these systems are as follows:
 - 1. Nominal Heating Value: 1000 Btu/cu.ft.
 - 2. Nominal Specific Gravity: 0.60
- C. Interruption of Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after

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arranging to provide purging and startup of natural-gas supply according to requirements indicated:

1. Notify Architect and Owner no fewer than two days in advance of proposed interruption of natural-gas service.
2. Do not proceed with interruption of natural-gas service without Architect and Owner's written permission.

1.8 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.2 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
 2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
 3. Cold press mechanical joint fittings: ASTM A420 or ASME B16.3. (*AD-05)
 - a. Sealing elements: Hydrogenated Nitrile Butadiene Rubber (HNBR)
 4. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
 5. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - a. Material Group: 1.1.
 - b. End Connections: Threaded or butt welding to match pipe.
 - c. Lapped Face: Not permitted underground.
 - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
 - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
 6. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
 - a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

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2.3 POLYETHYLENE PIPE, FITTINGS, AND JOINING MATERIALS

- A. Available Manufacturers:
 - 1. ERS Inc.
 - 2. Titeflex Corp.
- B. Polyethylene Pipe: Pipe shall be produced for use in gas distribution systems in accordance with the latest published edition of ASTM D 2513 Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings.
- C. Polyethylene Fittings: Fittings shall be produced for use in gas distribution systems in accordance with the latest published edition of ASTM D 2513 Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings.
- D. Joining Materials: Joining materials shall be as recommended by the pipe and fitting manufacturer for service intended.

2.4 PROTECTIVE COATING

- A. Furnish pipe and fittings with factory-applied, corrosion-resistant polyethylene coating for use in corrosive atmosphere.

2.5 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.6 VALVES

- A. Refer to section "General Duty Valves for Plumbing Piping".

2.7 PIPING SPECIALTIES

- A. Appliance Flexible Connectors:
 - 1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
 - 2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
 - 3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
 - 4. Corrugated stainless-steel tubing with polymer coating.
 - 5. Operating-Pressure Rating: 0.5 psig
 - 6. End Fittings: Zinc-coated steel.
 - 7. Threaded Ends: Comply with ASME B1.20.1.
 - 8. Maximum Length: 72"

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B. 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 2" and smaller; flanged ends for 2 ½" and larger.
3. Strainer Screen: 40-mesh startup strainer and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

C. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.8 SPECIALTY VALVES

A. Available Manufacturers:

1. ASCO General Controls.
2. Automatic Switch Co.
3. Eaton Corp.; Controls Div.
4. Honeywell, Inc.
5. Johnson Controls, Inc.

B. Automatic Gas Valves: ANSI Z21.21, with electrical or mechanical operator for actuation by appliance automatic shutoff device.

2.9 Valves, 2" and Smaller: Ball valves with threaded ends according to ASME B1.20.1 for pipe threads.

2.10 Valves, 2-1/2" and Larger: Butterfly valves for use with flanged ends according to ASME B16.5 for steel flanges.

2.11 PRESSURE REGULATORS

A. Available Manufacturers:

1. Line Pressure Regulators:
 - a. American Meter Co.
 - b. Donkin: Bryan Donkin RMG Canada, Ltd.
 - c. Eclipse Combustion, Inc.
 - d. Equimeter, Inc.
 - e. Fisher Controls International, Inc.
 - f. Maxitrol Co.
 - g. National Meter.
 - h. Richards Industries, Inc.; Jordan Valve Div.
 - i. Schlumberger Industries; Gas Div.

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- B. Description: Single stage and suitable for fuel gas service. Include steel jacket and corrosion-resistant components, elevation compensator, and atmospheric vent.
1. 2" and Smaller: Threaded ends according to ASME B1.20.1 for pipe threads.
 2. 2 ½" and Larger: Flanged ends according to ASME B16.5 for steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.
 3. Line Pressure Regulators: ANSI Z21.80 with 5-psig minimum inlet pressure rating.
 4. Appliance Pressure Regulators: ANSI Z21.18 with 2-psig minimum inlet pressure. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction. If vents are required provided piping necessary to extend to termination location outside the building as approved by the architect.
- C. Pressure Regulator Vents: Factory- or field-installed, corrosion-resistant screen in opening if not connected to vent piping. Extend to exterior of building and terminate in location approved by the architect.
- D. Appliance Pressure Regulators: Comply with ANSI Z21.18.
1. Available Manufacturers:
 - a. Canadian Meter Company Inc.
 - b. Eaton Corporation; Controls Div.
 - c. Harper Wyman Co.
 - d. Maxitrol Company.
 - e. SCP, Inc.
 2. Body and Diaphragm Case: Die-cast aluminum.
 3. Springs: Zinc-plated steel; interchangeable.
 4. Diaphragm Plate: Zinc-plated steel.
 5. Seat Disc: Nitrile rubber.
 6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
 7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
 8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
 9. Maximum Inlet Pressure: 2 psig.

2.12 CONCRETE BASES

- A. Description: Reinforced concrete base formed of 3000-psi- minimum, 28-day compressive strength concrete, and measuring 6 inches thick and 6 inches larger in each dimension than equipment, unless otherwise indicated.

2.13 DIELECTRIC FITTINGS

- A. Dielectric Unions:
1. Available Manufacturers:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Hart Industries International, Inc.
 - d. McDonald, A. Y. Mfg. Co.
 - e. Watts Regulator Co.; Division of Watts Water Technologies, Inc.

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- f. Wilkins; Zurn Plumbing Products Group.
2. Minimum Operating-Pressure Rating: 150 psig.
3. Combination fitting of copper alloy and ferrous materials.
4. Insulating materials suitable for natural gas.
5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

B. Dielectric Flanges:

1. Available Manufacturers:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
 - d. Wilkins; Zurn Plumbing Products Group.
2. Minimum Operating-Pressure Rating: 150 psig.
3. Combination fitting of copper alloy and ferrous materials.
4. Insulating materials suitable for natural gas.
5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

C. Dielectric-Flange Kits:

1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
2. Minimum Operating-Pressure Rating: 150 psig.
3. Companion-flange assembly for field assembly.
4. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or PE bolt sleeves, phenolic washers, and steel backing washers.
5. Insulating materials suitable for natural gas.
6. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

2.14 LABELING AND IDENTIFYING

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

PART 3 - EXECUTION

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3.1 EXAMINATION

- A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Inspect natural-gas piping according to the 2021 Virginia Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.
- B. Comply with the 2021 Virginia Fuel Gas Code requirements for prevention of accidental ignition.

3.3 SERVICE ENTRANCE PIPING

- A. Extend fuel gas piping and connect to fuel gas distribution piping downstream of meter.
 - 1. Service meter will be provided by Local Gas Utility.
- B. Install dielectric fitting downstream from and adjacent to each service meter unless meter is supported from service-meter bar with integral dielectric fitting. Install shutoff valve downstream from and adjacent to dielectric fitting. Refer to Division 22 Section "Common Work Results for Plumbing" for dielectric fittings.

3.4 CONCRETE BASE INSTALLATION

- A. Locate bases at service meters and service regulators.
- B. Excavate earth and make level beds to support bases. Form and pour concrete bases level with top surface projecting approximately 3 inches above grade.

3.5 OUTDOOR PIPING INSTALLATION

- A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Section "Earth Moving" for excavating, trenching, and backfilling.
 - 1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.
- C. Install underground, PE, natural-gas piping according to ASTM D 2774.
- D. Steel Piping Protective Coating:
 - 1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.

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2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
- E. Copper Tubing Protective Coating:
 1. Apply joint cover kits over tubing to cover, seal, and protect joints.
 2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer. Install fittings for changes in direction and branch connections.
- F. Install pressure gage upstream and downstream from each service regulator. Pressure gages are specified in Section "Meters and Gages for Plumbing Piping."

3.6 INDOOR PIPING INSTALLATION

- A. Comply with the 2021 Virginia Fuel Gas Code for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to are accepted by architect.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms.
- E. Install piping indicated to be exposed and piping in equipment rooms at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.
- H. Install natural-gas piping at uniform grade toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Verify final equipment locations for roughing-in.
- L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and

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

- N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
- P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.
 - 1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
 - 2. In Floors: Install pre-sleeved corrugated, stainless-steel tubing systems for natural-gas. Cover with minimum of 1-1/2 inches of concrete. Jacket may not be in physical contact with metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives.
 - 3. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
 - a. Exception: Tubing passing through partitions or walls does not require striker barriers.
 - 4. Prohibited Locations:
 - a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
 - b. Do not install natural-gas piping in solid walls or partitions.

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- Q. Connect branch piping from top or side of horizontal piping.
- R. Install unions in pipes 2" and smaller, adjacent to each valve, at final connection to each piece of equipment and where otherwise indicated. Unions are not required at flanged connections.
- S. Do not use natural-gas piping as grounding electrode.
- T. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- U. Install pressure gage upstream and downstream from each line regulator. Pressure gages are specified in Section "Meters and Gages for Plumbing Piping."
- V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section "Sleeves and Sleeve Seals for Plumbing Piping."
- W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section "Sleeves and Sleeve Seals for HVAC Piping."
- X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."
- Y. Install corrugated, stainless-steel tubing system according to manufacturer's written instructions. Include striker plates to protect tubing from puncture where tubing is restrained and cannot move.
- Z. Install containment casings for gas piping below slabs extending minimum of 2 inches beyond point where pipe emerges from the floor. Tightly seal ends around gas piping using mechanical sleeve seals.

3.7 SERVICE-METER ASSEMBLY INSTALLATION

- A. Provide concrete base for service meter.
- B. Install locking shutoff valves downstream from service regulator. Shutoff valves are not required at second regulator if two regulators are installed in series.
- C. Install strainer on inlet of service-pressure regulator.
- D. Install service pressure regulator mounted outside with vent outlet horizontal or facing down. Install screen in vent outlet if not integral with service regulator.
- E. Install metal shutoff valves upstream from service meters. Install dielectric fittings downstream from service meters.

3.8 VALVE INSTALLATION

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- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.
- B. Install underground valves with valve boxes.
- C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

3.9 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 - 2. Cut threads full and clean using sharp dies.
 - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
 - 4. Apply appropriate tape or thread compound to external pipe threads unless dry-seal threading is specified.
 - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints:
 - 1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
 - 2. Bevel plain ends of steel pipe.
 - 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
- E. Cold Press Joints:
 - 1. Pipe and fittings shall comply with ANSI LC-4/CSA 6.32 and the latest edition of NFPA-54.
 - 2. Fittings shall comply with requirements of ASTM F3226.
- F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.
- G. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not over-tighten.
- H. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.

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3.10 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hangers and supports specified in Section "Hangers and Supports for Plumbing Piping and Equipment."
- B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
 - 1. 1" and Smaller: Maximum span, 96"; minimum rod size, 3/8".
 - 2. 1¼": Maximum span, 108"; minimum rod size, 3/8".
 - 3. 1½" and 2": Maximum span, 108"; minimum rod size, 3/8".
 - 4. 2½" to 3 ½": Maximum span, 10'-0"; minimum rod size, ½".
 - 5. 4" and Larger: Maximum span, 10'-0"; minimum rod size, 5/8".

3.11 CONNECTIONS

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

3.12 PIPING APPLICATIONS

- A. Flanges, unions, transition, and special fittings with pressure ratings same as or higher than system pressure rating may be used in applications below, unless otherwise indicated.
- B. Above Ground Exposed Fuel Gas Piping:
 - 1. Sizes up to 2":
 - a. Steel pipe, malleable-iron threaded fittings, and threaded joints.
 - b. Steel pipe, cold press fittings.
 - 2. 2½" to 4": Steel pipe, malleable-iron threaded fittings, and threaded joints, or steel pipe, steel welding fittings, and welded joints.
 - 3. Larger Than NPS 4: Steel pipe, steel welding fittings, and welded joints.
- C. Above Ground Concealed Fuel Gas Piping:
 - 1. Sizes up to 2":
 - a. Steel pipe, malleable-iron threaded fittings, and threaded joints.
 - b. Steel pipe, cold press fittings.
 - 2. 2½" to 4": Steel pipe, malleable-iron threaded fittings, and threaded joints, or steel pipe, steel welding fittings, and welded joints.
 - 3. Larger Than NPS 4: Steel pipe, steel welding fittings, and welded joints.

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D. Exterior Underground Fuel Gas Piping:

1. All Sizes: Polyethylene pipe, fittings and joining materials.

E. Under Slab Fuel Gas Piping: (NOTICE: Method of fuel gas piping installation below floor slab must be approved by the local code authority.)

1. Pre-Sleeved Corrugated, Stainless-Steel Tubing Systems.
2. Steel pipe, steel welding fittings, and welded joints with welded steel vented conduit.

3.13 LABELING AND IDENTIFYING

A. Comply with requirements in Section "Identification for Plumbing Piping and Equipment" for piping and valve identification.

B. Install detectable warning tape directly above gas piping, 12" minimum below finished grade.

1. Exception: 6 minimum below sub-grade under pavements and slabs.

3.14 PAINTING

A. Use materials and procedures in Division 9 Section "Painting," "Exterior Paint Schedule" Article, "Ferrous Metal" Paragraph, "Full-Gloss, Alkyd-Enamel Finish" Subparagraph.

B. Paint exterior service meters, pressure regulators, specialty valves, and piping.

1. Color: Gray.

3.15 FIELD QUALITY CONTROL

A. Inspect, test, and purge piping according to ANSI Z223.1, Part 4 "Inspection, Testing, and Purging," and requirements of authorities having jurisdiction.

B. Repair leaks and defects with new materials and retest system until satisfactory results are obtained.

C. Report test results promptly and in writing to Architect and authorities having jurisdiction.

D. Verify capacities and pressure ratings of service meters, pressure regulators, valves, and specialties.

E. Verify correct pressure settings for pressure regulators.

F. Verify that specified piping tests are complete.

3.16 ADJUSTING

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- A. Adjust controls and safety devices. Replace damaged and malfunctioning controls and safety devices.

END OF SECTION 221113

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing domestic water piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
 - 1. Domestic Water Service Piping: 160 psig.
 - 2. Domestic Water Distribution Piping: 125 psig.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Remaining paragraphs are defined in Division 01 Section "Submittal Procedures" as "Informational Submittals."
- C. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Fire-suppression-water piping.
 - 2. Domestic water piping.
 - 3. Sanitary waste piping
 - 4. HVAC hydronic piping.

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.

1.5 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

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PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. 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.

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
 2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 4. 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.
 5. Copper Pressure-Seal-Joint Fittings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Elkhart Products Corporation; Industrial Division.
 - 2) Nibco Inc.
 - 3) Viega; Plumbing and Heating Systems.
 - 4) Victaulic Company.
 - b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 - c. NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 6. Grooved-Joint Copper-Tube Appurtenances:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Anvil International.
 - 2) Shurjoint Piping Products.
 - 3) Victaulic Company.
 - b. Copper Grooved-End Fittings: ASTM B 75 copper tube or ASTM B 584 bronze castings.
 - c. Grooved-End-Tube Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts.
- B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.
1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

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2. Copper Pressure-Seal-Joint Fittings:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Elkhart Products Corporation; Industrial Division.
 - 2) NIBCO INC.
 - 3) Viega; Plumbing and Heating Systems.
- b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
- c. NPS 3 and NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

2.3 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - 1. Standard-Pattern, Mechanical-Joint Fittings: AWWA C110, ductile or gray iron.
 - 2. Compact-Pattern, Mechanical-Joint Fittings: AWWA C153, ductile iron.
 - a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - 1. Standard-Pattern, Push-on-Joint Fittings: AWWA C110, ductile or gray iron.
 - a. Gaskets: AWWA C111, rubber.
 - 2. Compact-Pattern, Push-on-Joint Fittings: AWWA C153, ductile iron.
 - a. Gaskets: AWWA C111, rubber.
- C. Plain-End, Ductile-Iron Pipe: AWWA C151.
 - 1. Grooved-Joint, Ductile-Iron-Pipe Appurtenances:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Anvil International.
 - 2) Shurjoint Piping Products.
 - 3) Star Pipe Products.
 - 4) Victaulic Company.
 - b. Grooved-End, Ductile-Iron Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.

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- c. Grooved-End, Ductile-Iron-Pipe Couplings: AWWA C606 for ductile-iron-pipe dimensions. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts.

2.4 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise 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/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.5 TRANSITION FITTINGS

- A. General Requirements:
 - 1. Same size as pipes to be joined.
 - 2. Pressure rating at least equal to pipes to be joined.
 - 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Coupling: AWWA C219.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cascade Waterworks Manufacturing.
 - b. Dresser, Inc.; Dresser Piping Specialties.
 - c. Ford Meter Box Company, Inc. (The).
 - d. JCM Industries.
 - e. Romac Industries, Inc.
 - f. Smith-Blair, Inc; a Sensus company.
 - g. Viking Johnson; c/o Mueller Co.

2.6 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.

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B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. EPCO Sales, Inc.
 - d. Hart Industries International, Inc.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - f. Zurn Plumbing Products Group; Wilkins Water Control Products.
2. Description:
 - a. Pressure Rating: 150 psig at 180 deg F.
 - b. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. EPCO Sales, Inc.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Factory-fabricated, bolted, companion-flange assembly.
 - b. Pressure Rating: 150 psig.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
2. Description:
 - a. Nonconducting materials for field assembly of companion flanges.
 - b. Pressure Rating: 150 psig.
 - c. Gasket: Neoprene or phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.
 - e. Washers: Phenolic with steel backing washers.

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E. Dielectric Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Calpico, Inc.
 - b. Lochinvar Corporation.
2. Description:
 - a. Galvanized-steel coupling.
 - b. Pressure Rating: 300 psig at 225 deg F.
 - c. End Connections: Female threaded.
 - d. Lining: Inert and noncorrosive, thermoplastic.

F. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Perfection Corporation; a subsidiary of American Meter Company.
 - b. Precision Plumbing Products, Inc.
 - c. Victaulic Company.
2. Description:
 - a. Electroplated steel nipple complying with ASTM F 1545.
 - b. Pressure Rating: 300 psig at 225 deg F.
 - c. End Connections: Male threaded or grooved.
 - d. Lining: Inert and noncorrosive, propylene.

2.7 FLEXIBLE CONNECTORS

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

1. Flex-Hose Co., Inc.
2. Flexicraft Industries.
3. Flex Pression, Ltd.
4. Flex-Weld, Inc.
5. Hyspan Precision Products, Inc.
6. Mercer Rubber Co.
7. Metraflex, Inc.
8. Proco Products, Inc.
9. Tozen Corporation.
10. Unaflex, Inc.
11. Universal Metal Hose; a Hyspan company

B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

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1. Working-Pressure Rating: Minimum 250 psig.
 2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
 3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.
- C. 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 250 psig.
 2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
 3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

2.8 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, Deep Pattern: Deep-drawn, box-shaped brass with chrome-plated finish.
- D. One Piece, Stamped Steel: Chrome-plated finish with setscrew.
- E. Split Casting, Cast Brass: Polished, chrome-plated finish with concealed hinge and setscrew.
- F. Split Plate, Stamped Steel: Chrome-plated finish with exposed-rivet hinge, setscrew.
- G. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- H. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.9 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. 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.

2.10 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Advance Products & Systems, Inc.
 2. Calpico, Inc.
 3. Metraflex, Inc.
 4. Pipeline Seal and Insulator, Inc.

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- B. 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: Carbon steel.
 - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.11 WALL PENETRATION SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. SIGMA.
- B. Description: Wall-sleeve assembly, consisting of housing and gland, gaskets, and pipe sleeve.
 - 1. Carrier-Pipe Deflection: Up to 5 percent without leakage.
 - 2. Housing: Ductile-iron casting with hub, waterstop, anchor ring, and locking devices. Include gland, bolts, and nuts.
 - 3. Housing-to-Sleeve Gasket: EPDM rubber.
 - 4. Housing-to-Carrier-Pipe Gasket: AWWA C111, EPDM rubber.
 - 5. Pipe Sleeve: AWWA C151, ductile-iron pipe.

2.12 GROUT

- A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

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3.2 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 ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105.
- E. 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.
- F. Install shutoff valve immediately upstream of each dielectric fitting.
- G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.
- H. Install domestic water piping level without pitch and plumb.
- I. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- K. 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.
- L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- M. Install piping adjacent to equipment and specialties to allow service and maintenance.
- N. Install piping to permit valve servicing.
- O. 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.
- P. Install piping free of sags and bends.
- Q. Install fittings for changes in direction and branch connections.

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- R. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- S. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.
- T. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22 Section "Domestic Water Pumps" for thermostats.
- U. Install thermometers on outlet piping from each water heater. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

3.3 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. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Braze Joints" Chapter.
- E. 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."
- F. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. Copper-Tubing Grooved Joints: Roll groove end of tube. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for roll-grooved joints.
- H. Ductile-Iron-Piping Grooved Joints: Cut groove end of pipe. Assemble coupling with housing, gasket, lubricant, and bolts. Join ductile-iron pipe and grooved-end fittings according to AWWA C606 for ductile-iron-pipe, cut-grooved joints.
- I. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

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- J. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 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 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 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. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."
 - 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
 - 2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.
- D. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for calibrated balancing valves.

3.5 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. NPS 1-1/2 and Smaller: Fitting-type coupling.
 - 2. NPS 2 and Larger: Sleeve-type coupling.

3.6 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.
- D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

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3.7 FLEXIBLE CONNECTOR INSTALLATION

- A. Install flexible connectors in suction and discharge piping connections to each domestic water pump and in suction and discharge manifold connections to each domestic water booster pump.
- B. Install bronze-hose flexible connectors in copper domestic water tubing.
- C. Install stainless-steel-hose flexible connectors in steel domestic water piping.

3.8 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 and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet If Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
 - 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
- E. Install supports for vertical copper tubing every 10 feet.
- F. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
 - 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
 - 3. NPS 2: 10 feet with 3/8-inch rod.
 - 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
 - 5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
 - 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.

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- G. Install supports for vertical steel piping every 15 feet.
- H. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.9 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. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
 - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 3. 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.
 - 4. 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 and larger.

3.10 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.
 - 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 - 4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish.
 - 5. Bare Piping in Equipment Rooms: One piece, stamped steel with set screw or spring clips.
 - 6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.
- C. Escutcheons for Existing Piping:
 - 1. Chrome-Plated Piping: Split casting, cast brass with chrome-plated finish.
 - 2. Insulated Piping: Split plate, stamped steel with concealed hinge and spring clips.

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3. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish.
4. Bare Piping at Ceiling Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish.
5. Bare Piping in Unfinished Service Spaces: Split casting, cast brass with polished chrome-plated finish.
6. Bare Piping in Equipment Rooms: Split plate, stamped steel with set screw or spring clips.
7. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting floor plate.

3.11 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. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. 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.
- G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals specified in this Section.
- I. Seal space outside of sleeves in concrete slabs and walls with grout.
- J. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- K. 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 Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Steel pipe.
 - a. Extend sleeves 2 inches above finished floor level.
 - b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to

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extend sleeve to 2 inches above finished floor level. Comply with requirements in Division 07 Section "Sheet Metal Flashing and Trim" for flashing.

3. Sleeves for Piping Passing through Gypsum-Board Partitions:
 - a. Steel pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.
 - c. Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
4. Sleeves for Piping Passing through Exterior Concrete Walls:
 - a. Steel pipe sleeves for pipes smaller than NPS 6.
 - b. Cast-iron wall pipe sleeves for pipes NPS 6 and larger.
 - c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
 - d. Do not use sleeves when wall penetration systems are used.
5. Sleeves for Piping Passing through Interior Concrete Walls:
 - a. Steel pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.

- L. 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.

3.12 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.

3.13 WALL PENETRATION SYSTEM INSTALLATION

- A. Install wall penetration systems in new, exterior concrete walls.
- B. Assemble wall penetration system components with sleeve pipe. Install so that end of sleeve pipe and face of housing are flush with wall. Adjust locking devices to secure sleeve pipe in housing.

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3.14 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.

3.15 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. All test results will be included in O&M manual.
- 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. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - 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 above operating pressure, 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.

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- E. Prepare test and inspection reports.
 - 1. A copy of the water testing and a water test sample will be submitted to the designer and Wake County.

3.16 ADJUSTING

- A. Perform the following adjustments before operation:
 - 1. Close drain valves, hydrants, and hose bibbs.
 - 2. Open shutoff valves to fully open position.
 - 3. Open throttling valves to proper setting.
 - 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 - 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 - 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 - 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 - 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.17 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
 - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Prepare and submit reports of purging and disinfecting activities.

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1. A copy of the water testing and a water test sample will be submitted to the designer and Wake County.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.18 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.
- D. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 and larger, shall be one of the following:
1. Soft copper tube, ASTM B 88, Type K; wrought-copper solder-joint fittings; and brazed joints.
 2. Mechanical-joint, ductile-iron pipe; standard- or compact- pattern mechanical-joint fittings; and mechanical joints.
- E. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be the following:
1. Soft copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
- F. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:
1. Hard copper tube, ASTM B 88, Type L; wrought- copper solder-joint fittings; and soldered joints.
 2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
- G. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following:
1. Hard copper tube, ASTM B 88, Type L; wrought- copper solder-joint fittings; and brazed joints.
 2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
 3. Hard copper tube, ASTM B 88, Type L; grooved-joint copper-tube appurtenances; and grooved joints.

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3.19 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Shutoff Duty: Provide ball valves for piping NPS 2 and smaller. Provide butterfly, or ball valves with flanged ends for piping NPS 2-1/2 and larger.
 - 2. Throttling Duty: Provide ball valves for piping NPS 2 and smaller. Provide butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
 - 3. Hot-Water Circulation Piping, Balancing Duty: Provide automatic flow control valves.
 - 4. Drain Duty: Provide Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- C. Grooved-end valves may be used with grooved-end piping.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 PERFORMANCE REQUIREMENTS

- A. 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: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

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. 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."

0.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.
- B. Installer: Company specializing in performing the work of this section with minimum two years documented experience.

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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: Rough bronze.

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 1011.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Rough bronze.

C. Spill-Resistant Vacuum Breakers: (VB-1 thru VB-4)

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

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- a. Conbraco Industries, Inc.
 - b. Watts Industries, Inc.; Water Products Div.
- 2. Standard: ASSE 1056.
 - 3. Operation: Continuous-pressure applications.
 - 4. Size: NPS 1/2.
 - 5. Accessories:
 - a. Valves: Ball type, on inlet and outlet.

2.2 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers and products. Retain one of first three subparagraphs and list of manufacturers below. See Division 01 Section "Product Requirements."

- 1. Basis-of-Design Product: Provide the product indicated on the Drawing Schedule or a comparable product by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Zurn Plumbing Products Group; Wilkins Div.
- 2. Standard: ASSE 1013.
- 3. Operation: Continuous-pressure applications.
- 4. Pressure Loss: 15 psig Insert pressure maximum, through middle 1/3 of flow range.
- 5. Pressure Loss at Design Flow Rate: 14psig for sizes NPS 2 and smaller; 15psig for NPS 2-1/2 and larger.
- 6. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
- 7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
- 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; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

B. Reduced-Pressure-Detector, Fire-Protection Backflow-Preventer Assemblies:

- 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.

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- d. Watts Industries, Inc.; Water Products Div.
- e. Zurn Plumbing Products Group; Wilkins Div.
- 2. Standard: ASSE 1047 and FMG approved or UL listed.
- 3. Operation: Continuous-pressure applications.
- 4. Body: Cast iron with interior lining complying with AWWA C550 or that is FDA approved.
- 5. End Connections: Flanged.
- 6. Configuration: Designed for horizontal, straight through flow.
- 7. Accessories:
 - a. Valves: Outside screw and yoke gate-type with flanged ends on inlet and outlet.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
 - c. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

C. Hose-Connection Backflow Preventers:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Watts Industries, Inc.; Water Products Div.
 - c. Woodford Manufacturing Company.
- 2. Standard: ASSE 1052.
- 3. Operation: Up to 10-foot head of water back pressure.
- 4. Inlet Size: NPS 1/2 or NPS 3/4.
- 5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
- 6. Capacity: At least 3-gpm flow.

D. 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 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

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1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Flo Fab Inc.
 - c. ITT Industries; Bell & Gossett Div.
 - d. NIBCO INC.
 - e. TAC Americas.
 - f. Taco, Inc.
 - g. Watts Industries, Inc.; Water Products Div.
 2. Type: Ball valve with two readout ports and memory setting indicator.
 3. Body: bronze,
 4. Size: Same as connected piping, but not larger than NPS 2.
 5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.
- B. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.
- C. 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: Standard or 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.
- D. Individual-Fixture, Water Tempering Valves:
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. Lawler Manufacturing Company, Inc.

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- e. Leonard Valve Company.
 - f. Powers; a Watts Industries Co.
 - g. Watts Industries, Inc.; Water Products Div.
 - h. Zurn Plumbing Products Group; Wilkins Div.
-
- 2. Standard: ASSE 1016, thermostatically controlled water tempering valve.
 - 3. Pressure Rating: 125 psig minimum, unless otherwise indicated.
 - 4. Body: Bronze body with corrosion-resistant interior components.
 - 5. Temperature Control: Adjustable.
 - 6. Inlets and Outlet: Threaded.
 - 7. Finish: Rough or chrome-plated bronze.
 - 8. Tempered-Water Setting: 105 deg F.
 - 9. Tempered-Water Design Flow Rate: 2 gpm.

2.4 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

- 1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
- 2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
- 3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
- 4. Screen: Stainless steel with round perforations, unless otherwise indicated.
- 5. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.033 inch.
 - b. Strainers NPS 2-1/2 to NPS 4: 0.062 inch.
 - c. Strainers NPS 5 and Larger: 0.10 inch.
- 6. Drain: Factory-installed, hose-end drain valve.

2.5 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.

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2.6 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Manufacturers: Sizes on drawings based on Jay R Smith HYDROTROL models, fixture units, and PDI symbols A-F. Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Josam Company.
 - c. PPP Inc.
 - d. Sioux Chief Manufacturing Company, 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; 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.

2.7 AIR VENTS

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.
2. Pressure Rating: 125-psig minimum pressure rating at 140 deg F.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents:

1. Body: Stainless steel.
2. Pressure Rating: 150-psig minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

2.8 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Thermostatic Water Mixing Valves:

1. Available Manufacturers:
 - a. Lawler Manufacturing Company, Inc.
 - b. Leonard Valve Company.
 - c. Powers; a Watts Industries Co.

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- d. Symmons Industries, Inc.
 - e. Acorn Controls.
 - f. Armstrong International
 - 2. Standard: ASSE 1017.
 - 3. Pressure Rating: 125 psig.
 - 4. Material: Bronze body with corrosion-resistant interior components.
 - 5. Connections: union inlets and outlet.
 - 6. Accessories:
 - a. Check stops on hot- and cold-water supplies.
 - b. Handle.
 - c. Dial thermometer on inlets and outlet.
 - d. Pressure gauges on inlets and outlet.
 - 7. Pressure Rating: 125 psig, unless otherwise indicated.
- B. Individual-Fixture, Water Tempering Valves:
- 1. Refer to drawing schedule for manufacturer and operating requirements.
 - 2. Available Manufacturers:
 - a. Apollo Valves - Conbraco Industries, Inc.
 - b. Lawler Manufacturing Company, Inc.
 - c. Leonard Valve Company.
 - d. Acorn Controls.
 - e. Powers; a Watts Industries Co.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Plumbing Products Group; Wilkins Div.
 - 3. Standard: ASSE 1016, thermostatically controlled water tempering valve.
 - 4. Pressure Rating: 125 psig minimum, unless otherwise indicated.
 - 5. Body: Bronze body with corrosion-resistant interior components.
 - 6. Temperature Control: Adjustable.
 - 7. Inlets and Outlet: Threaded. Provide unions and valves.
 - 8. Finish: Chrome-plated bronze.

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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 water control valves with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
- E. Install balancing valves in locations where they can easily be adjusted.
- F. 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.
 - 2. Install cabinet-type units recessed in or surface mounted on wall as specified.
- G. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve and solenoid valve,.
- H. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."
- I. Install water hammer arresters in water piping according to PDI-WH 201.
- J. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.
- K. 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.
- L. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

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3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Pressure vacuum breakers.
 - 2. Intermediate atmospheric-vent backflow preventers.
 - 3. Reduced-pressure-principle backflow preventers.
 - 4. Reduced-pressure-detector, fire-protection backflow-preventer assemblies.
 - 5. Double-check, detector-assembly backflow preventers.
 - 6. Water pressure-reducing valves.
 - 7. Calibrated balancing valves.
 - 8. Primary water tempering valves.
 - 9. Outlet boxes.
 - 10. Supply-type, trap-seal primer valves.
 - 11. Trap-seal primer systems.
- B. 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."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
 - 1. Test each pressure vacuum breaker, reduced-pressure-zone backflow preventer, double-check backflow-prevention assembly, and double-check detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.
 - 2. Submit completed backflow testing report to designer and Wake County.
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

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- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

3.5 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 221119

SECTION 221125 - CIRCULATING PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

- A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.3 ABBREVIATIONS

- A. BAS Building Automation System

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include materials of construction, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Operation and Maintenance Data: For domestic water pumps to include in 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. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect against damage.
- C. Comply with pump manufacturer's written instructions for handling.

PART 2 - PRODUCTS

2.1 CIRCULATING PUMPS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Armstrong Pumps Inc.
 - 2. Bell & Gossett Domestic Pump; ITT Corporation.
 - 3. Grundfos Pumps Corp.
- B. Description: Factory-assembled and -tested, in-line, wet rotor or system lubricated, close-coupled, 100% lead free, overhung-impeller, designed for circulating domestic hot water.
- C. Pump Construction:
 - 1. Pump and Motor Assembly: Hermetically sealed, cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal.
 - 2. Motor: Non-overloading at all points on the pump curve
 - 3. Casing: Bronze, with companion-flange connections.
 - 4. Impeller: Plastic.
 - 5. Motor: Single speed, unless otherwise indicated.

2.2 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 22 Section "Common Motor Requirements for Plumbing Equipment."
 - 1. 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.
 - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

2.3 CONTROLS

- A. BAS: Electric, adjustable for control of water-supply pump.
 - 1. Type: Start/Stop
 - 2. Operation of Pump: Refer to Section "Sequence of Operation".

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.
- B. Verify installation and location of automatic flow control valve(s). Record actual location(s) on as-built drawings.

3.2 PUMP INSTALLATION

- A. Comply with HI 1.4.
- B. Install in-line, centrifugal pumps with shaft horizontal unless otherwise indicated.

3.3 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to pumps to allow service and maintenance.
- C. Connect domestic water piping to pumps.
- D. Install suction and discharge piping.
- E. Install indicated valves & devices.
- F. Comply with Division 26 Sections for electrical connections.
- G. Connect controls.
- H. Interlock pump with water heater to deactivate water heater when pump is deactivated.

3.4 IDENTIFICATION

- A. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification of pumps.

3.5 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Check piping connections for tightness.
 - 3. Clean strainers on suction piping.
 - 4. Check operation of controls for automatic starting and stopping operation of pumps.
 - 5. Perform the following startup checks for each pump before starting:

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- a. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - b. Verify that pump is rotating in the correct direction.
6. Prime pump.
7. Close discharge valve.
8. Start motor.
9. Open discharge valve slowly.
10. Adjust temperature settings on thermostatic mixing valves if included in design.
11. Adjust balancing valves if required by thermostatic mixing valve manufacturer.
12. Check and record pressure on inlet and outlet of pump.

END OF SECTION 221125

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. LLDPE: Linear, low-density polyethylene plastic.
- C. NBR: Acrylonitrile-butadiene rubber.
- D. PE: Polyethylene plastic.
- E. PVC: Polyvinyl chloride plastic.
- F. TPE: Thermoplastic elastomer.

1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding a minimum working pressure of 10-foot head of water.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other marking of testing agency.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. All cast iron soil pipe and fittings shall be marked with the Collective Trademark of the Cast Iron Soil Pipe Institute.

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- B. Pipe and Fittings: ASTM A 74, Service and Extra-Heavy class(es).
- C. Gaskets: ASTM C 564, rubber.

2.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. All cast iron soil pipe and fittings shall be marked with the Collective Trademark of the Cast Iron Soil Pipe Institute.
- B. Pipe and Fittings: ASTM A 888 or CISPI 301.
- C. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 - 1. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
 - a. Manufacturers:
 - 1) ANACO-Husky.
 - 2) Clamp-All Corp.
 - 3) Mission Rubber Co.

2.4 STEEL PIPE AND FITTINGS

- A. Pressure-Seal-Joint-End, ASTM A312, Type 304/304L, Schedule 5S Stainless Steel Pipe: NPS 2 and smaller; full finished annealed pipe, certified for use with press couplings and fittings.
 - 1. Pressure-Seal-Joint Piping Systems:
 - a. Manufacturers:
 - 1) Victaulic Co. of America.
 - 2) Viega; Plumbing and Heating Systems
 - b. Pressure-Seal-Joint-End Fittings: UL-listed, ASTM A 403, WPW, WPW/S9, or CR/S9, or shall be fabricated from cold drawn stainless steel type A304/304L, with EPDM-rubber O-ring seal in each end.
- B. Grooved-End, ASTM A312, Type 304/304L or 316/316L, Schedule 10 Stainless Steel Pipe: Schedule 10 in NPS 2 1/2 and larger; with factory- or field-formed, roll-grooved ends.
 - 1. Grooved-Joint Piping Systems:
 - a. Manufacturers:
 - 1) Victaulic Co. of America.
 - 2) Ward Manufacturing.
 - b. Grooved-End Fittings: UL-listed, ASTM A 403, WPW, WPW/S9, or CR/S9, or shall be fabricated from stainless steel pipe conforming to ASTM A312, with

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factory grooved ends. Fittings shall be type 304/304L or 316/316L stainless steel casting with OD matching steel-pipe OD.

- c. Grooved-End-Pipe Couplings: UL-Listed, ASTM A 351, A 743 and A 744, rigid pattern, unless otherwise indicated; gasketed fitting matching stainless steel-pipe OD. Include stainless steel housing with keys matching stainless steel-pipe and fitting grooves, pressure responsive synthetic gasket, ASTM D 2000 listed for use with housing, and stainless steel bolts and nuts.

2.5 COPPER TUBE AND FITTINGS

- A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

- 1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

2.6 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

- 1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

- B. Solvent Cement and Adhesive Primer:

- 1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- B. Aboveground, soil and waste piping shall be the following:
 - 1. Hubless cast iron soil piping with heavy-duty couplings
 - 2. Kitchen equipment waste: copper dwv pipe and fittings.
- C. Underground, Soil, Waste, and Vent Piping: Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 2. Kitchen Waste: Extra Heavy Hub and Spigot cast-iron soil piping.
 - 3. Other than kitchen waste: PVC pipe and fittings.

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3.3 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 cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."
- D. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.
- E. 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.
- F. 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.
- G. 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 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 - 2. Building Vacuum Waste Piping: 2 percent downward in direction of flow.
 - 3. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow for piping NPS 2-1/2 and smaller; 1 percent downward in direction of flow for piping NPS 3 and larger.
 - 4. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- H. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- I. Install underground PVC soil and waste drainage piping according to ASTM D 2321.
- J. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

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- K. Install underground PVC soil and waste drainage piping according to ASTM D 2321.
- L. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- M. All system piping under slab and underground shall be video inspected to verify piping integrity, condition, and slope. Video record shall be provided to designer and Wake County at substantial completion. Any sections found to be compromised during inspections shall be replaced and repaired by contractor.

3.4 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- C. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
- D. Grooved Joints: Assemble joint with keyed coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- E. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.5 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. Install individual, straight, horizontal piping runs according to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring 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 minimum rods.

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- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 - 2. NPS 3: 60 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 - 4. NPS 6: 60 inches with 3/4-inch rod.
 - 5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.
- F. Install supports for vertical cast-iron soil piping every 15 feet.
- G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 3. NPS 2-1/2: 108 inches with 1/2-inch rod.
 - 4. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 - 5. NPS 6: 10 feet with 5/8-inch rod.
 - 6. NPS 8: 10 feet with 3/4-inch rod.
- H. Install supports for vertical copper tubing every 10 feet.
- I. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
 - 2. NPS 3: 48 inches with 1/2-inch rod.
 - 3. NPS 4 and 5: 48 inches with 5/8-inch rod.
 - 4. NPS 6: 48 inches with 3/4-inch rod.
 - 5. NPS 8 to NPS 12: 48 inches with 7/8-inch rod.
- J. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. 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.
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.

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4. Equipment: Connect drainage piping as indicated. Use flanges instead of unions for connections NPS 2-1/2 and larger.

3.7 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. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 1. 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 separate report for each test, complete with diagram of portion of piping tested.
 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
 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 required corrective action.

3.8 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.

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- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.9 PROTECTION

- A. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 ABBREVIATIONS

- A. RPZ Reduced Pressure Zone
- B. FOG Fats, oils, and greases.

1.3 DEFINITIONS

- A. Withstand: Units shall remain in place without separation of any parts when subjected to seismic forces indicated. "Essential facility" units shall be fully operational after the seismic event.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:
 - 1. Grease interceptors.
 - 2. Oil interceptors.
- B. Shop Drawings:
 - 1. Provide Wiring Diagrams: Power, signal, and control wiring.
- C. Manufacturer Seismic Qualification Certification: Submit certification that grease interceptors, oil interceptors, accessories, and components will withstand seismic forces defined in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings: Identify center of gravity and locate & describe mounting and anchorage provisions.
 - 3. Detailed Description: Provide detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Operation and Maintenance Data: To include in emergency, operation, and maintenance manuals.

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1.5 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Electrical components, devices, and accessories shall be 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. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.6 COORDINATION

- A. Coordinate size and location of roof penetrations.
- B. Coordinate accessories, extensions, collars, flashing clamps, etc... for field conditions and installation requirements for roof assemblies and other construction assemblies to provide final and proper compliant installation.

PART 2 - PRODUCTS

2.1 CLEANOUTS

- A. General:
 - 1. Available Manufacturers:
 - 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
 - 2. Standard: ASME A112.36.2M.
 - 3. Size: Same as connected drainage piping
 - 4. Closure Material: Match pipe, brass, PVC, or ABS
- B. Floor Cleanouts:
 - 1. Housing: threaded, adjustable.
 - 2. Type: Threaded, adjustable housing.
 - 3. Body: Cast iron.
 - 4. Outlet Connection: Inside calk, Spigot, or Threaded.
 - 5. Adjustable Housing Material: Cast iron with threads.
 - 6. Frame and Cover Material and Finish: Satin finish nikaloy.
 - 7. Frame and Cover Shape: Round or Square (Contractors Option).
 - 8. Top Loading Classification: Extra Heavy Duty.
 - 9. Riser: ASTM A 74, Service weight, cast-iron drainage pipe fitting and riser to cleanout.
 - 10. Carpet Ring: Yes for carpeted floors.

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11. Tile Recess: Yes for tiled floors.
12. Terrazzo: Yes for terrazzo floors

C. Wall Cleanouts:

1. Wall access: Yes
2. Body: Match connected piping.
3. Closure: Countersunk or raised-head, drilled-and-threaded plug.
4. Closure Plug Size: Same as cleanout size but not larger than four inches in diameter.
5. Wall Access: Round, flat, chrome-plated brass, nickel-bronze, copper-alloy, or stainless-steel cover plate with screw.

2.2 FLOOR DRAINS

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Tyler Pipe; Wade Div.
 - d. Watts Drainage Products Inc.
 - e. Zurn Plumbing Products Group; Light Commercial Operation.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.3
3. Pattern: As indicated.
4. Clamping Flange: Required.

2.3 TRENCH DRAINS

A. Trench Drains:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of 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 A112.6.3 for trench drains.
3. Material: Ductile or gray iron.
4. Clamping Flange: Required.
5. Top Loading Classification: Extra Heavy-Duty.

2.4 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

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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. ProSet Systems Inc.
2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
5. Plastic Stack Fitting (For Use Where Plastic Stacks Are Indicated): ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
6. Special Coating (For Use Where Plastic Laboratory Stacks are Indicated: Corrosion resistant on interior of fittings.

2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Floor-Drain, Trap-Seal Primer Fittings:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. PPP
 - b. Josam
 - c. Smith
 - d. Zurn
2. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
3. Size: Same as floor drain inlet.

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.

2.6 GREASE INTERCEPTORS

- A. General: Grease and solids interceptor having capacity indicated (Refer to Plumbing Schedules).
- B. Design: Interceptor shall be designed to remove from wastewater free oil, grease, and other floatable materials, and sediment, sand and other settleable materials.

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- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
- D. Available Manufacturers:
 - 1. GreenTurtleTech
 - 2. Highland Tank
 - 3. Schier Products
- E. Equivalent interceptors constructed of fiberglass or steel by other manufacturers will be considered. Interceptor manufacturer must document compliance with all requirements of this specification. Capacity information must be from the manufacturer's catalog. Site constructed concrete interceptors are not acceptable.
- F. Interceptor shall meet the requirements of the International Association of Plumbing and Mechanical Officials (IAPMO) Material and Property Standard for Grease Interceptors and Clarifiers ANSI/IAPMO Z1001-2007.
- G. Steel Interceptors shall be in accordance with Underwriters Laboratories Inc. Subject UL-1746 Standard for External Corrosion Protection Systems for Steel Underground Storage Tanks.
- H. Interceptor shall consist of inlet and outlet connections with internal influent nozzle, non-clogging flow diffusion and energy dissipater baffle. If distributed pipe configuration is proposed pipe diameter shall be twice the diameter of the inlet pipe and shall direct flow across the entire cross-sectional area. Straight pipe is not acceptable.
- I. Interceptor shall be designed to prevent large amounts of pipe-clogging fats, oil, and grease (FOG) and solid waste materials from entering the sanitary sewer system. Interceptor shall have compartments to minimize turbulence and promote separation. Interceptor shall retain wastewater long enough to allow liquefied grease to cool down, separate, and congeal.
- J. Interceptor shall be suitable for underground installation and shall be installed per the manufacturer's recommendations.
- K. Provide interceptor with cleanouts, sample, and ventilation ports together with extension collars, frames, and covers to allow access for removal of oil, grease and solids.
- L. Accessories:
 - 1. Basin manways with extensions to grade and heavy duty covers.
 - 2. Full line-size connections.
 - 3. Vertical tee fitting on discharge outlet with pipe to surface with cast iron frame and cover for effluent sampling.
 - 4. Traffic rated components accessories and relieving slabs where installation subject to vehicular traffic.
 - 5. Grease level monitoring and alarm system
- M. Warranty: 30 years against leakage, corrosion, and structural failure.

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2.7 MOTORS

- A. General requirements for motors are specified in Division 22 Section "Common Motor Requirements for Plumbing Equipment."
 - 1. 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.
 - 2. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

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.
- C. Install cleanout deck plates with top flush with finished floor.
- D. For wall cleanouts located in concealed piping, install cleanout access covers, with cover tight to 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 as indicated. If indication is not clear, position for easy access and maintenance.
 - 2. Set floor drains at elevations indicated.
 - 3. Install floor-drain flashing flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - 4. Install individual traps for floor drains connected to sanitary building drain.
- F. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.
- G. Install through-penetration firestop assemblies in plastic conductors and stacks at rated penetrations.
- H. Install floor-drain, trap-seal primer fittings on inlet to floor drains indicated to receive trap-seal primer.
- I. Install air-gap fittings on RPZ backflow preventers and where indicated.
- J. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

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- K. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction, manufacturer's recommendations/instructions, and as indicated. In case of a conflict, consult architect.
- L. Install oil interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction, manufacturer's recommendations/instructions, and as indicated. In case of a conflict, consult architect. Coordinate oil-interceptor storage tank and gravity drain with Division 22 Section "Facility Fuel-Oil Piping."

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.
- C. Grease Interceptors: Connect inlet and outlet to unit, and connect flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic drawoff-type unit.
- D. Oil Interceptors: Connect inlet, outlet, vent, and gravity drawoff piping to unit; flow-control fitting and vent to unit inlet piping; and gravity drawoff and suction piping to oil storage tank.
- E. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Grease interceptors.
 - 2. Oil interceptors.
 - 3. Solids interceptors.
- B. Distinguish among multiple units, inform operator of operational requirements, and refer to Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect grease interceptors and their installation, including piping [**and electrical connections,**] and to assist in testing.
- B. Checks and Inspections:

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1. Leak Check: After installation, charge system and check for leaks. Repair leaks and recheck until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 PROTECTION

- A. Protect drains during construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of open pipes at end of each day or when work stops.

END OF SECTION 221319

SECTION 223400 - FUEL-FIRED, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

- A. Product Data: For each type and size of domestic-water heater proposed. Include rated capacities, operating characteristics, electrical characteristics, furnished specialties and accessories.
- B. LEED Submittal: Product Data for Prerequisite EA 2: Documentation indicating that units comply with ASHRAE/IESNA 90.1, Section 7, "Service Water Heating."
- C. Wiring Diagrams: For power, signal, and control wiring.
- D. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- E. Operation and Maintenance Data: For fuel-fired, domestic-water heaters to include in emergency, operation, and maintenance manuals.
- F. Warranty: Sample of warranty.

1.3 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. ASHRAE/IESNA 90.1 Compliance: Fabricate and label fuel-fired, domestic-water heaters to comply with ASHRAE/IESNA 90.1.
- C. ASME Compliance:
 - 1. Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 - 2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube, domestic-water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."

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1.4 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.5 WARRANTY

- A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Structural failures including storage tank and supports.
 - b. Faulty operation of controls.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
 2. Warranty Period from date of Substantial Completion:
 - a. Storage Tank(s): Five years.
 - b. Controls and Other Components: One year.
 - c. Compression Tanks: Five years.

PART 2 - PRODUCTS

- A. General:
1. The basis of design for each water heater shall be as indicated on drawings. The contractor shall provide equivalent products by one of the listed manufacturers.
 2. Manufacturers:
 - a. Lochinvar Corporation.
 - b. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
 - c. State Industries.
 3. Neutralization: Provide all condensing gas-fired domestic water heaters with condensate neutralization kits from water heater manufacturer. Coordinate location and drain requirements with drains and equipment indicated on plans.

2.2 COMMERCIAL, GAS-FIRED, STORAGE, DOMESTIC-WATER HEATERS

A. Commercial, Gas-Fired, High-Efficiency, Storage, Domestic-Water Heaters:

1. Standard: ANSI Z21.10.3/CSA 4.3.
 - a. Description: Manufacturer's proprietary design to provide at least 95 percent combustion efficiency at optimum operating conditions.
2. Storage-Tank Construction: ASME-code steel with 150-psig minimum working-pressure rating.
 - a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.

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- 1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
 - 2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.
 - b. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 3. Factory-Installed Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
 - c. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
 - d. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
 - e. Jacket: Steel with enameled finish.
 - f. Burner or Heat Exchanger: Comply with UL 795 or approved testing agency requirements for gas-fired, high-efficiency, domestic-water heaters and natural-gas fuel.
 - g. Temperature Control: Adjustable thermostat.
 - h. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
 - i. Combination Temperature-and-Pressure Relief Valves: ANSI Z21.22/CSA 4.4-M. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
 4. Draft Hood: Draft diverter, complying with ANSI Z21.12.
- B. Capacity and Characteristics: Refer to Plumbing drawings and schedules.
1. Minimum Vent Diameter: Refer to and coordinate with manufacturer's written installation recommendations and Mechanical drawings and schedules.
- 2.3 DOMESTIC-WATER HEATER ACCESSORIES
- A. The basis of design for each Compression Tank shall be as indicated. The contractor shall provide an equivalent product.
- B. Domestic-Water Compression Tanks:
1. Available Manufacturers:
 - a. AMTROL Inc.
 - b. Honeywell International Inc.
 - c. Pentair Pump Group (The); Myers.
 - d. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
 - e. State Industries.
 - f. Taco, Inc.
 - g. Hubbell

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- 2. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
 - C. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than ¾" with ASME B1.20.1 pipe threads.
 - D. Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2 Heat-Trap Fitting.
 - E. Gas Shutoff Valves: ANSI Z21.15/CSA 9.1-M, manually operated. Furnish for installation in piping.
 - F. Gas Pressure Regulators: ANSI Z21.18/CSA 6.3, appliance type. Include rating to match gas supply & water heater requirement.
 - G. Combination Temperature-and-Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank. ANSI Z21.22/CSA 4.4-M or ASME rated and stamped.
 - H. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4-M.
 - I. Plug and cord:
 - 1. Where water heaters require 120 volt single phase power, provide a plug and cord, for connection to a standard grounded outlet.
 - 2. Cord length: As required to reach outlet, 6'-0" maximum.
 - 3. Plug and cord ampacity shall be approved by the water heater manufacturer.
 - J. Intake Venting:
 - 1. Air Intake Termination: PVC gooseneck elbow with bird screen.
 - 2. CPVC/PVC as recommended by water heater manufacturer.
- 2.4 SOURCE QUALITY CONTROL
- A. Run/fire water heaters prior to shipment.
 - B. Hydrostatically test water heaters and storage tanks to minimum of one and one-half times pressure rating prior to shipment.
 - C. Domestic-water heaters will be considered defective if they leak or do not operate correctly. Comply with requirements in Section "Quality Requirements" for re-testing and re-inspecting requirements and Section "Execution" for requirements for correcting the Work.
 - D. Prepare test and inspection reports.

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PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

- A. Commercial, Domestic-Water Heater Mounting: Install commercial domestic-water heaters on concrete base.
 - 1. Maintain manufacturer's recommended clearances.
- B. Install commercial domestic-water heaters with seismic-restraint devices.
- C. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend relief-valve outlet, with drain piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- D. Install water-heater tank drain as indicated. Install hose-end drain valves. Comply with requirements for hose-end drain valves specified in Section "Domestic Water Piping Specialties."
- E. Install thermometer on outlet piping of domestic-water heaters. Comply with requirements for thermometers specified in Division 22 Section "Meters and Gages for Plumbing Piping."
- F. Assemble and install inlet and outlet piping manifold kits for multiple domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each domestic-water heater outlet. Comply with requirements for valves specified in Division 22 Section "General-Duty Valves for Plumbing Piping," and comply with requirements for thermometers specified in Division 22 Section "Meters and Gages for Plumbing Piping."
- G. Install heat traps on inlet and outlet piping.
- H. Fill with water.
- I. Charge compression tanks with air.

3.2 CONNECTIONS

- A. Comply with requirements for domestic-water piping specified in Section "Domestic Water Piping."
- B. Drawings indicate general arrangement of piping, fittings, and specialties.
- C. Where installing piping adjacent to water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

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3.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. 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.
 - 2. Leak Test: After installation, charge system 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 operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section "Quality Requirements" for retesting and reinspecting requirements and Section "Execution" for requirements for correcting the Work.
- C. Prepare test and inspection reports.

3.5 DEMONSTRATION

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

END OF SECTION 223400

SECTION 224200 - 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 conventional plumbing fixtures and related components:
 - 1. Water closets.
 - 2. Lavatories.
 - 3. Commercial sinks.
 - 4. Kitchen sinks.
 - 5. Service sinks.
 - 6. Service basins.
- B. Related Sections include the following:
 - 1. Division 10 Section "Toilet, Bath, and Laundry Accessories."
 - 2. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.
 - 3. Division 22 Section "Security Plumbing Fixtures."
 - 4. Division 22 Section "Emergency Plumbing Fixtures."

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. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- D. FRP: Fiberglass-reinforced plastic.
- E. PMMA: Polymethyl methacrylate (acrylic) plastic.
- F. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.
- D. Warranty: Special warranty specified in this Section.
- E. LEED Submittals:
 - 1. Credit WE 3: Manufacturers' data for each type of plumbing fixture indicating flow and flush rates.
 - 2. Credit EQ 4.1: Manufacturers' product data for adhesives and sealants used inside the weatherproofing system indicating VOC content of each product in grams per Liter (g/L).

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
 - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- 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. 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.
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

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- G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
1. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
 2. Vitreous-China Fixtures: ASME A112.19.2M.
- H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
 2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
 3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
 4. Faucets: ASME A112.18.1.
 5. Hose-Connection Vacuum Breakers: ASSE 1011.
 6. Hose-Coupling Threads: ASME B1.20.7.
 7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 8. NSF Potable-Water Materials: NSF 61.
 9. Pipe Threads: ASME B1.20.1.
 10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 11. Supply Fittings: ASME A112.18.1.
 12. Brass Waste Fittings: ASME A112.18.2.
- I. 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. Brass Waste Fittings: ASME A112.18.2.
 5. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
- J. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Floor Drains: ASME A112.6.3.
 2. Grab Bars: ASTM F 446.
 3. Hose-Coupling Threads: ASME B1.20.7.
 4. Off-Floor Fixture Supports: ASME A112.6.1M.
 5. Pipe Threads: ASME B1.20.1.
 6. Plastic Toilet Seats: ANSI Z124.5.
 7. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 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.

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1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
3. Flushometer Valve, Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than 2 of each type.
4. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.
5. Water-Closet Tank, Repair Kits: Equal to 5 percent of amount of each type installed.
6. Toilet Seats: Equal to 5 percent of amount of each type installed.

PART 2 - PRODUCTS

2.1 WATER CLOSETS

A. WATER CLOSET - ACCESSIBLE (WC-1) WITH MANUAL FLUSH VALVE:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Kohler No. K-84325-0 (1.28 Gallon Flush)
 - a. Material: Vitreous china
 - b. Color: White
2. Flush Valve: Sloan Model 111XL-1.28 (1.28 Gallon Flush)
 - a. Supply Rough-in Elevation: 11-1/2" above spud connection
 - b. Provide:
 - 1) Accessible handle located on wide side of approach..
 - 2) Sweat Solder Adapter and Cast Wall Flange with Set Screw.
3. Seat: Church 9500SSCT (White)
 - 1) Elongated extra heavy weight seat with stainless steel self-sustaining check hinge.
 - 2) Open front, no cover

B. WATER CLOSET - (WC-2) WITH MANUAL FLUSH VALVE:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Kohler No. K-84325-0 (1.28 Gallon Flush)
 - a. Material: Vitreous china
 - b. Color: White
2. Flush Valve: Sloan Model 111XL-1.28 (1.28 Gallon Flush)
 - a. Supply Rough-in Elevation: 11-1/2" above spud connection
 - b. Provide:
 - 1) Accessible handle located on wide side of approach..
 - 2) Sweat Solder Adapter and Cast Wall Flange with Set Screw.
3. Seat: Church 9500SSCT (White)
 - 1) Elongated extra heavy weight seat with stainless steel self-sustaining check hinge.

- 2) Open front, no cover

2.2 LAVATORIES

A. WALL HUNG LAV – ACCESSIBLE (LV-1) WITH MANUAL FAUCET

1. Basis-of-Design Product: Subject to compliance with requirements, provide Kohler No. K-1728 or a comparable product by one of the following:
 - a. Material: Vitreous china
 - b. Color: White
2. Faucet: Moen Model: 8820
 - a. 4" Spout
 - b. 1.2 GPM Maximum Flow
 - c. Chrome plate
 - d. All Brass Body
 - e. Renewable Seat and Washers
 - f. Wrist Blade Handles
3. Drain: McGuire Part Number 155A
4. Trap: McGuire Part Number 8902C-F
 - 1) 1-1/4"x 1-1/2" cast brass polished chrome trap with cleanout plug and brass slip nuts.
 - 2) 17-gauge seamless tubular chrome plated brass wall bend.
 - 3) Forged brass chrome plated wall flange with setscrew.
5. Supplies: McGuire Part Number 2165-N3-F
 - 1) 1/2" IPS x 3/8" OD
 - 2) 1/2" x 3" chrome plated brass nipple.
 - 3) Heavy brass chrome plated wall flange with set-screw
 - 4) Contractor shall coordinate supply connection to faucet.
6. Insulation: Tru-Bro Lav Guard #102
 - 1) Color: White
 - 2) Insulate P-trap, hot and cold angle valves, hot and cold risers.
7. Fixture Carrier: Select Josam, Smith or other manufacturer's fixture carrier to suit installation in terms of clear space available in the chase, waste pipe configuration, and waste piping location.
8. Other Manufacturers: Provide products, features, and accessories equal to those specified above.
 - 1) Lavatory
 - a) American Standard
 - b) Eljer
 - c) Gerber
 - 2) Faucet:
 - a) Speakman
 - b) Cambridge Brass
 - c) T&S Brass

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- 3) Drain:
 - a) Kohler
 - b) Cambridge Brass
 - c) Chicago
- 4) Trap:
 - a) Kohler
 - b) Cambridge Brass
- 5) Supplies:
 - a) Cambridge Brass
 - b) Kohler
- 6) Insulation:
 - a) McGuire

2.3 COMMERCIAL SINKS

A. SINK – SINGLE BASIN - ACCESIBLE (SK-1):

- 1. Manufacturer & Model Number: Elkay LRAD2219
 - a. 6" bowl depth
 - b. Punched for 4" centerset faucet
- 2. Material: 18 Gauge Stainless Steel
- 3. Faucet: Zurn model Z812B4-XL
 - a. 5.33" Swing Gooseneck Spout
 - b. 1.5 GPM pressure compensating aerator.
 - c. Handles: 4" wristblade
 - d. Renewable Ceramic disc cartridges
 - e. Meets ADA requirements: Yes
 - f. Polished chrome finish
 - g. All brass body
- 4. Basket Strainer & Tail Piece: McGuire Part Number 151
 - a. Forged brass basket strainer.
 - b. 1-1/2" x 4" 20 gauge tailpiece
 - c. Cast brass lock and coupling nuts
- 5. Trap: McGuire Part Number 8912-C-F
 - a. 1-1/2"x 1-1/2" cast brass polished chrome trap with cleanout plug and brass slip nuts.
 - b. 17-gauge seamless tubular chrome plated brass wall bend.
 - c. Forged brass chrome plated wall flange with setscrew.
- 6. Supplies: McGuire Part Number 2165-N3-F
 - a. 1/2" IPS x 3/8" OD
 - b. 1/2" x 3" chrome plated brass nipple.
 - c. Heavy brass chrome plated wall flange with set-screw
 - d. Contractor shall coordinate supply connection to faucet.
 - e. Wheel Handle
- 7. Other Manufacturers: Provide products, features, and accessories equal to those specified above.
 - a. Sink
 - 1) Just
 - 2) Kohler

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- b. Faucet:
 - 1) T&S
 - 2) Speakman
 - 3) Chicago
 - 4) Moen
- c. Basket Strainer & Tail Piece:
 - 1) Kohler
 - 2) Cambridge Brass
- d. Trap:
 - 1) Kohler
 - 2) Cambridge Brass
- e. Supplies:
 - 1) Cambridge Brass
 - 2) Kohler

2.4 SERVICE BASIN

A. SERVICE MOP BASIN (32"X32") (MS-1)

B. Manufacturer & Model Number: Stern-Williams Serviceptor Model SB-702

- 1. Shoulders shall not be less than 9" high inside measurement, and not less than 1" wide. The tiling flange shall be cast integral to the unit and shall extend 1" above the shoulder on 2 sides. Basin shall be composed of marble chips and Portland cement ground smooth and sealed to resist stains. A one piece, 20 gauge, type 302 stainless steel stainless steel cap shall be integrally cast into the unit on four sides.
 - a. Dimensions: 32"x 32"x 12".
 - b. Cap: Stainless steel on 4 sides.
 - c. Tiling Flange: Yes on two sides.
 - d. Material: Terrazzo
 - e. Color: Manufacturer's standard

C. Faucet: Moen Model 8232

- 1. 8" center
- 2. Vacuum breaker spout
- 3. Lever Handles
- 4. Integral supply check-stops
- 5. Pail hook
- 6. Wall support

D. Drain: Cast brass with stainless steel strainer or equal as furnished with sink.

E. Trap: 3" (Provide additional pipe and material transition as required make connection to sink)

F. Other Manufacturers: Provide products, features, and accessories equal to those specified above.

- 1. Service Sink
 - a. Fiat
 - b. Just

- c. Florestone
- 2. Faucet:
 - a. T&S
 - b. Chicago
 - c. Speakman

2.5 HOSE BIBB (HB-1)

- A. Manufacturer and Model Number: Apollo Model HB
 - 1. Vacuum Breaker: Yes (separate). Apollo 38-304
 - 2. Outlet: ASME B1.20.7, garden-hose threads.
 - 3. 3/4" Inlet
 - 4. Ball valve 1/4 turn or compression.
 - 5. Brass Construction
 - 6. Aluminum, brass, stainless steel, or steel handle
- B. Available Manufacturers:
 - 1. T&S
 - 2. Chicago
 - 3. Arrowhead Brass

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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.

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- 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 counter-mounting fixtures in and attached to casework.
- G. Install fixtures level and plumb according to roughing-in drawings.
- H. 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.
 - 1. Exception: Use ball valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- I. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- J. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- K. 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.
- L. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
- M. Install toilet seats on water closets.
- N. 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.
- O. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- P. 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.
- Q. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- R. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

- S. Install escutcheons at piping wall 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."
- T. Set service basins in leveling bed of cement grout. Grout is specified in Division 22 Section "Common Work Results for Plumbing."
- U. 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."

3.3 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."

3.4 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.

3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Operate and adjust controls. Replace damaged and malfunctioning units and controls.

- C. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.
- D. Replace washers and seals of leaking and dripping faucets and stops.
- E. Install fresh batteries in sensor-operated mechanisms.

3.6 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 - 2. Remove sediment and debris from drains.
- B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 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 224200

SECTION 224600 - SECURITY 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 security plumbing fixtures and related components:
 - 1. Combination units.
 - 2. Lavatories.
 - 3. Water closets.
 - 4. Showers.
 - 5. Detox toilets
 - 6. Fixture supports for front-mounting, stainless-steel fixtures and wall-mounting fixtures.
- B. Related Sections include the following:
 - 1. Division 10 Section "Toilet, Bath, and Laundry Accessories."
 - 2. Division 22 Section "Plumbing Fixtures."

1.3 DEFINITIONS

- A. Accessible Fixture: Security plumbing fixture that can be approached and used by people with disabilities.
- B. Back-Mounting-Type Fixture: Security plumbing fixture designed to mount on wall sleeve built into wall so installation and removal of fixture and piping and other components are only accessible from service space behind wall.
- C. Front-Mounting-Type Fixture: Security plumbing fixture designed to mount on fixture support with installation and removal from fixture side of wall, and piping and other components are accessible from access panels in fixture or wall.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include furnished specialties and accessories.
- B. Shop Drawings: Diagram power, signal, and control wiring.

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- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For security plumbing fixtures 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, 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" ; about security plumbing fixtures for people with disabilities.
- C. NSF Standard: Comply with NSF 61, "Drinking Water System Components - Health Effects," for fixture materials that will be in contact with potable water.
- D. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

1.6 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. Flushometer Valves: Equal to 10 percent of amount installed for each type indicated, but no fewer than 2 units.
 - 2. Electronic Lavatory and Shower Valves: Equal to 15 percent of amount installed for each type indicated, but no fewer than 3 units.

PART 2 - PRODUCTS

2.1 COMBINATION UNITS

- A. Security Combination Units - Accessible, **(PWA-1)**:
 - 1. Basis-of-Design Product: Willoughby Model 4896

Description: On-floor mounting ligature-resistant combination unit, Handicap-ADA compliant, back-mounting, rear access, security water closet/lavatory; fabricated from 14-gauge thickness, ASTM A 666, Type 304 stainless steel. Include SSINA No. 4 polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.

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2. Water Closet/Lavatory:

a. Unit:

- 1) Left-hand or Right-hand configuration. See plans
- 2) ECW - Wall outlet
- 3) WS - Wall sleeve (omit for Steel Cell wall)
- 4) PBH – Ligature resistant pneumatic push buttons
- 5) DMBC - Code bubbler/filler (w/mouth guard) - Deck mounted
- 6) PC3 - Pinned cleanout plug – 3”PVC
- 7) OV – Lavatory overflow
- 8) PML2 - Dual temp pneumatic metering lavatory valve
- 9) T4A – Toilet overflow preventer with auto reset
- 10) TWE - 3” PVC toilet waste extension
- 11) TWC3P – Toilet waste coupling
- 12) LWE - Lavatory waste extension
- 13) LW2 1-1/2” PVC lavatory waste coupling
- 14) TSC - Toilet shipping cover
- 15) FVT – Flush valve connection

b. Flush Valve: Willoughby/Sloan Flush Valve (1.28 Gal. Flush)

c. Refer to plans for orientation.

3. Wall Sleeve: Galvanized-steel frame of dimensions required to match and support entire fixture. Include steel bars or other design that will prevent escape if fixture is removed. (omit for Steel Cell wall)

4. Joint Sealant:

- a. Place security (Dynaflex or equal, slightly flexible) caulk around the entire fixture interface as it touches either the floor or wall.

5. Other Manufacturers: Provide products, features, and accessories equal to those specified above.

a. Fixture:

- 1) Acorn
- 2) I-Con
- 3) Willoughby

b. Flush Valve:

- 1) Acorn
- 2) I-Con
- 3) Willoughby

B. Security Combination Units, **(PWA-2)**:

1. Basis-of-Design Product: Willoughby Model 1546

Description: On-floor mounting combination unit, back-mounting, rear access, security water closet/lavatory; fabricated from 14-gauge thickness, ASTM A 666, Type 304 stainless steel. Include SSINA No. 4 polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.

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2. Water Closet/Lavatory:

a. Unit:

- 1) Left-hand or Right-hand configuration. See plans
- 2) ECW - Wall outlet
- 3) WS - Wall sleeve (omit for Steel Cell wall)
- 4) PBH - Ligature resistant pneumatic push buttons
- 5) DMBC - Code bubbler/filler (w/mouth guard) - Deck mounted
- 6) PC3 - Pinned cleanout plug - 3"PVC
- 7) OV - Lavatory overflow
- 8) PML2 - Dual temp pneumatic metering lavatory valve
- 9) T4A - Toilet overflow preventer with auto reset
- 10) TWE - 3" PVC toilet waste extension
- 11) TWC3P - Toilet waste coupling
- 12) LWE - Lavatory waste extension
- 13) LW2 1-1/2" PVC lavatory waste coupling
- 14) TSC - Toilet shipping cover
- 15) FVT - Flush valve connection

b. Flush Valve: Willoughby/Sloan Flush Valve (1.28 Gal. Flush)

c. Refer to plans for orientation.

3. Wall Sleeve: Galvanized-steel frame of dimensions required to match and support entire fixture. Include steel bars or other design that will prevent escape if fixture is removed. (omit for Steel Cell wall)

4. Joint Sealant:

- a. Place security (Dynaflex or equal, slightly flexible) caulk around the entire fixture interface as it touches either the floor or wall.

5. Other Manufacturers: Provide products, features, and accessories equal to those specified above.

a. Fixture:

- 1) Acorn
- 2) I-Con
- 3) Willoughby

b. Flush Valve:

- 1) Acorn
- 2) I-Con
- 3) Willoughby

C. Security Combination Units - Accessible, **(PWA-3)**:

1. Basis-of-Design Product: Willoughby Model 1545

Description: On-floor mounting combination unit for 45-degree chase, Handicap-ADA compliant, back-mounting, rear access, security water closet/lavatory; fabricated from 14-gauge thickness, ASTM A 666, Type 304 stainless steel. Include SSINA No. 4 polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.

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2. Water Closet/Lavatory:
 - a. Unit
 - 1) E1L2 - Dual temp electronic metering lavatory valve
 - 2) WMSII – Electronic Controls
 - 3) FVT – Flush valve connection
 - b. Flush Valve: EFVP Electronic Willoughby/Sloan Flush Valve (1.28 Gal. Flush)
 - c. Refer to plans for orientation.
3. Wall Sleeve: Galvanized-steel frame of dimensions required to match and support entire fixture. Include steel bars or other design that will prevent escape if fixture is removed. (omit for Steel Cell wall)
4. Joint Sealant:
 - a. Place security (Dynaflex or equal, slightly flexible) caulk around the entire fixture interface as it touches either the floor or wall.
5. Other Manufacturers: Provide products, features, and accessories equal to those specified above.
 - a. Fixture:
 - 1) Acorn
 - 2) I-Con
 - 3) Willoughby
 - b. Flush Valve:
 - 1) Acorn
 - 2) I-Con
 - 3) Willoughby

2.2 LAVATORIES

A. Security Lavatory – Accessible, (PLA-1):

1. Basis-of-Design Product: Willoughby Model HS-1014-96-HC

Description: 18” wide rear mounted handicap-ADA compliant rectangular bowl security lavatory, back-mounting, fabricated from 14-gauge thickness, ASTM A 666, Type 304 stainless steel. Include SSINA No. 4 polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.

- a. WS - Wall sleeve (omit for Steel Cell wall)
 - b. P2PB – Ligature resistant piezo electronic push buttons
 - c. DMBC – Code type Penal Filler/Bubbler with mouth guard – deck mounted
 - d. OV – Lavatory Overflow
 - e. LW2 – Lavatory waste extension
 - f. LW2 – 1-1/2” PVC Lavatory waste coupling
 - g. WMSII – Electronic Controls
2. Lavatory Valve: Willoughby series E1L2 dual temperature lead-free electronic metering valve.

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- a. Valve shall contain non-corrosive wet parts.
- b. Include the following:
 - 1) Check-stop and strainer assembly for each valve.
 - 2) Cycle interrupt: Allows the user to interrupt the cycle by pushing the fixture pushbutton.
- 3. Joint Sealant:
 - a. Place security (Dynaflex or equal, slightly flexible) caulk around the entire fixture interface as it touches either the floor or wall.
- 4. Other Manufacturers: Provide products, features, and accessories equal to those specified above.
 - a. Acorn
 - b. I-Con
 - c. Willoughby

2.3 SHOWER UNITS

A. ADA Security Shower Panel, **(PSH-1)**:

1. Basis-of-Design Product: Willoughby Model WRS-FA-ADA

Description: Front mounted Panel Shower, front access, ADA Compliant, recessed shower panel in wall.

- a. 2HD - (2) Fixed Non-adjustable ligature resistant shower heads. Install heads at 72" and 48"
 - b. LRSH – Ligature resistant shower head (1.5 GPM controlled flow rate)
 - c. RD - Recessed soap dish
 - d. PML1 - Single temp pneumatic metering, dual manifold
 - e. PBH – Ligature resistant pneumatic push buttons
 - f. Material: 304 Stainless steel for fixture.
2. Valve: Willoughby PBH pneumatic metering valve.
- a. Valve shall contain non-corrosive wet parts.
 - b. Include the following:
 - 1) Check-stop and strainer assembly for each valve.
 - 2) Cycle interrupt: Allows the user to interrupt the cycle by pushing the fixture pushbutton.
3. Other Manufacturers: Provide products, features, and accessories equal to those specified above.
- a. Acorn
 - b. I-Con
 - c. Willoughby

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B. Security Shower Panel, **(PSH-2)**:

1. Basis-of-Design Product: Willoughby Model WRS-FA

Description: Front mounted, recessed shower panel in tile wall.

- a. LRSH – Ligature resistant shower head (1.5 GPM controlled flow rate)
- b. RD - Recessed soap dish
- c. PML1 - Single temp pneumatic metering, dual manifold
- d. PBH – Ligature resistant pneumatic push buttons
- e. Material: 304 Stainless-steel for fixture.

2. Valve: Willoughby PBH pneumatic metering valve.

- a. Valve shall contain non-corrosive wet parts.
- b. Include the following:
 - 1) Check-stop and strainer assembly for each valve.
 - 2) Cycle interrupt: Allows the user to interrupt the cycle by pushing the fixture pushbutton.

3. Other Manufacturers: Provide products, features, and accessories equal to those specified above.

- a. Acorn
- b. I-Con
- c. Willoughby

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before security plumbing fixture installation.
- B. Examine floors and walls for suitable conditions where security plumbing fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SECURITY PLUMBING FIXTURE INSTALLATION

- A. Install back-mounting-type, stainless-steel security plumbing fixtures as follows:
 - 1. Install wall sleeve in wall.
 - 2. Install fixture on wall sleeve; mount components on or attached to wall sleeve with access from accessible service space.

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3. Extend supply piping from service space to fixture.
4. Install soil and waste piping from fixture and extend into service space.
5. Install fixture trap in service space instead of below fixture drain.

B. Install front-mounting-type, stainless-steel security plumbing fixtures as follows:

1. Install fixture support or mounting bracket.
2. Install fixture on support; mount components inside of or attached to fixture.
3. Extend supply piping from pipe space to fixture.
4. Install trap below fixture and extend soil and waste piping into pipe space.

C. Install security plumbing fixture outlets with gasket seals.

D. Install fixtures designated "accessible" according to ICC A117.1 for heights, dimensions, and clearances.

E. Install fixtures level and plumb.

F. Install shutoff valves in water-supply piping to fixtures. Use ball, gate, or globe valve if specific type valve is not indicated. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

G. Install dielectric fittings in water-supply piping to fixtures if piping and fixture connections are made of different metals. See Division 22 Section "Common Work Results for Plumbing" for dielectric fittings.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect hot- and cold-water supply piping to security plumbing fixtures. Include supply stops, if specified, or ball valve on each supply. Ball valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

C. Connect soil and waste piping to security plumbing fixtures.

D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

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1. Testing: After installing security plumbing fixtures and after electrical circuitry has been energized, test for compliance with requirements.
2. Remove and replace malfunctioning security plumbing fixtures. Retest as specified above after repairs or replacements are made.

3.5 ADJUSTING

- A. Operate and adjust water-supply flushometers and flow-control valves on security plumbing fixtures.

3.6 CLEANING

- A. Clean security plumbing fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall spouts and strainers.
 2. Remove sediment and debris from drains.
- B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

- A. Provide protective covering for installed security plumbing fixtures and fittings.
- B. Do not allow use of security plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224600

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 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, 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 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.
- F. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.3 SUBMITTALS

- A. Product Data: For the following:
 - 1. Transition fittings.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Escutcheons.
- B. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Equipment and appliances comprising portions of the mechanical systems regulated by the applicable building codes shall be listed and labeled in accordance with the current edition of those codes.
- B. Equipment and appliances comprising portions of the mechanical systems shall be installed in accordance with the listing, manufacturer's installation instructions, and the applicable building codes. Manufacturer's installation instructions shall be available on the job site for use and inspection.
- C. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- D. 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.
- E. 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.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

1.6 INTENT OF CONTRACT DOCUMENTS

- A. Mechanical and HVAC drawings are diagrammatic, indicating general locations and arrangements of pipe, duct, and equipment. Not necessarily indicating all offsets, conditions, and appurtenances required to provide clearances for maximum practical accessibility to perform maintenance.
- B. Coordinate work in order to achieve proper operation and to provide a maintainable installed condition.
- C. Notify the Architect's representative immediately of conditions which do not comply or will not produce this result.
- D. Indicated configurations were used to size pipes, fans, pumps, expansion tanks and other devices. Install piping, duct, and equipment generally as indicated. Minor deviations are permitted in the course of necessary coordination. Major changes shall be submitted for

approval by the Architect's representative. Additional fittings and offsets not indicated are expected, anticipated by the design, and shall be provided. If more than 5% of the indicated number of fittings are required or if one change in direction is within six inches of another change in direction and this "Z" shape is not indicated notify the Architect's representative immediately. Provide necessary additional fittings and offsets. Changes in pipe size shall be made only with written approval from the Architect's representative.

1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to Section "Hydronic Piping" for additional 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 joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions inside & outside pipe and:
 - 1. ASME B16.21, non-metallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is otherwise 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.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated, and full-face or ring type, unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free (95% Tin, 5% Antimony) alloy. Include water-flushable flux according to ASTM B 813.

- D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- E. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.3 DIELECTRIC FITTINGS

- A. Where piping of dissimilar metals is joined together use yellow brass unions.

2.4 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral 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.
- E. Molded PE: Reusable, PE, tapered cup-shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.5 ESCUTCHEONS

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

- F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.6 GROUT

- A. Description: ASTM C 1107, Grade B, non-shrink and non-metallic, dry hydraulic cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, non-staining, non-corrosive, non-gaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.7 SECURITY FASTENERS:

- A. Description: Accessories, anchorage inserts, and security fasteners providing a complete tamperproof installation.
- B. Exposed Security Fasteners:
 - 1. Fastener: Provide **torx-head** (star with center reject pin) security fasteners for anchoring work in exposed security areas.
 - 2. Finish: Finish shall match that specified of the item anchored.
 - 3. Tools: Provide tools for fastening devices.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following 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 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.
- D. Install piping above accessible ceilings allowing sufficient space for ceiling panel removal.
- E. Install piping to permit valve operation & servicing.
- F. Install condensate drain piping at 1% slope.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections unless otherwise indicated.
- I. Install piping leaving room for installation of insulation.

- J. Install system components with pressure rating equal to or greater than system operating pressure.
- K. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. Exposed, Interior Installations/Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - 2. Exposed, Interior Installations/Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish and set-screw.
 - 3. Exposed, Interior Installations/Insulated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - 4. Exposed, Interior Installations/Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with finish to match surrounding surfaces.
 - 5. Exposed, Interior Installations/Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with finish to match surrounding surfaces.
 - 6. Exposed, Interior Installations/Piping in Unfinished Service Spaces: None, provide sealant.
 - 7. Exposed, Interior Installations/Piping in Equipment Rooms: None, provide sealant.
 - 8. Exposed, Interior Installations/Piping at Floor Penetrations in Equipment Rooms, Fan Rooms, or similar wet spaces: None - provide sealant and sleeve extending 2" above floor to prevent liquid leaking to floor below.
- L. Provide seal around piping penetrations of full height interior walls, both rated and non-rated, that occur above ceilings. Refer to Section 079200 Joint Sealants.
- M. Sleeves are not required for core-drilled holes.
 - 1. Exception: Exposed, Interior Installations at Floor Penetrations in Equipment Rooms, Fan Rooms, or similar wet spaces.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
 - 1. Exception: Exposed, Interior Installations at Floor Penetrations in Equipment Rooms, Fan Rooms, or similar wet spaces.
- O. Install sleeves for pipes passing through walls, floors, or roofs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment rooms, fan rooms or other similar wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring.
 - 2. Install sleeves as walls and slabs are constructed.
 - a. PVC Pipe Sleeves: Permitted for pipes smaller than 6" except aboveground, exterior-walls.
 - b. Steel Sheet Sleeves: Permitted for pipes 6" and larger, penetrating gypsum-board partitions except aboveground, exterior-walls.
 - c. Seal space outside sleeve fittings with grout and sealant.

3. Except for penetrations where mechanical sleeve seals are used, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Section "Joint Sealants".
- P. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for annular clear space required by the mechanical sleeve seal manufacturer between pipe and sleeve for installing mechanical sleeve seals.
 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
 4. Sleeves from an approved sleeve seal manufacturer shall be acceptable.
- Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Section "Penetration Firestopping" for materials.
- R. Verify final equipment locations for roughing-in.
- S. 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 water-flushable flux, unless otherwise indicated, to tube end. Construct joints using lead-free solder alloy.
- E. Brazed Joints: Construct joints using copper-phosphorus brazing filler metal.
- F. Threaded Joints: Thread pipe with tapered pipe threads. 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 otherwise indicated.
- G. Welded Joints: Construct joints using qualified processes and welding operators.

- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Mechanical Joints: Prepare pipe ends and fittings, apply coupling, and join according to joint manufacturer's written instructions.

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping 2" and smaller, one adjacent to each valve and at final connections to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2" and larger, adjacent to final connections to each piece of equipment.
 - 3. Install dielectric unions or flanges for connections of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are 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 service side of equipment.
- D. Install equipment to allow space for other systems.

3.5 PAINTING

- A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 HOUSEKEEPING PADS AND EQUIPMENT PADS

- A. Housekeeping pads and equipment pads: Anchor equipment to concrete according to equipment manufacturer's written instructions and according to seismic codes at project location.
 - 1. Construct concrete pads in accordance with drawing details.
 - 2. Details may be found on structural drawings. If details are not provided comply with the following:

- a. Housekeeping pads inside the building shall be 6" thick and 6" larger all around than supported equipment. Provide #4 rebar at 12" on center each way at mid-depth of slab. Provide a 3/4" chamfer on all edges.
- b. Equipment pads outside the building shall be 8" thick with a 12" deep and 20" wide turndown (footing) all around the outside edge of the pad. Provide #5 rebar at 16" on center each way at mid-depth of slab. Pad shall be 6" larger all around than supported equipment.
- c. Install dowel rods to connect housekeeping pad to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the pad. Provide a 1" chamfer on all edges.
- d. Install epoxy-coated anchor bolts. For equipment on housekeeping pads bolts shall extend through housekeeping pad, and anchor into structural concrete floor.
- e. Place and secure anchor bolts using supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions for placement.
- f. Install anchor bolts to elevations required for proper attachment to supported equipment.
- g. Install anchor bolts according to anchor bolt manufacturer's written instructions.
- h. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Section "Cast-in-Place Concrete".

3.7 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.

3.8 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.

3.9 SECURITY FASTENERS

- A. All fasteners exposed in security areas shall be security fasteners. Where standard fasteners on manufactured devices and equipment are accessible, they shall be replaced with security fasteners.

END OF SECTION 230500

SECTION 230513 – MOTORS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

- A. Manufacturer's catalog and efficiency data.

1.3 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.

1.4 COORDINATION

- A. All motors are required to be equipped with overload protection located near the motor.
 - 1. Overload protection shall:
 - a. Be located between the circuit breaker or fuse provided under Division 26 and the motor windings.
 - b. Meet one of the options specified in the following paragraph.
 - 2. Overload protection may be:
 - a. Located in the motor installed by the motor manufacturer. (preferred)
 - b. A separate device located near the motor.
 - c. Located in, or with, a disconnect switch provided by the equipment manufacturer. Provision of this switch shall not modify, change, or eliminate any Division 26 requirement. This means some equipment shall be provided or specified with two disconnecting means.
- B. Coordinate features of motors, installed units, and accessory devices. Provide motors that are:
 - 1. Compatible with controller
 - 2. Matched to torque and horsepower requirements of the load.
 - 3. Matched to ratings and characteristics of supply circuit and required control sequence.
- C. Coordinate motor support with requirements for driven load; access for maintenance and motor replacement; installation of accessories, belts, belt guards; and adjustment of sliding rails for belt tensioning.
- D. Belt tension must be wrench and socket adjustable.
- E. Belt tensioning device must accommodate adjustable sheaves.

PART 2 - PRODUCTS

2.1 MOTOR REQUIREMENTS

- A. Motor requirements apply except as follows:
1. Ratings, performance, or characteristics for a motor are specified in another Section or are scheduled on the drawings.
 2. Motor manufacturer requires ratings, performance, or characteristics, other than those specified to meet indicated performance.

2.2 MOTOR CHARACTERISTICS

- A. Frequency Rating: 60 Hz.
- B. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.
- C. Duty: Continuous at 105 deg F and 3300 feet above sea level.
- D. Capacity and Torque sufficient to:
1. Start, accelerate, and operate connected load.
 2. Maintain designated speeds.
 3. Operate at installed altitude and environment.
 4. Operate with indicated operating sequence.
 5. Operate without exceeding nameplate ratings.
 6. Operate without utilizing service factor.
- E. Enclosure: Open drip-proof unless otherwise indicated.
- F. Minimum Service Factor: 1.15 unless otherwise indicated.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. NEMA Premium efficiency motors shall meet the following full load efficiency:

HP	ODP			TEFC		
	6 Pole	4 Pole	2 Pole	6 Pole	4 Pole	2 Pole
1	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2	87.5	86.5	85.5	88.5	86.5	85.5
3	88.5	89.5	85.5	89.5	89.5	86.5
5	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10	91.7	91.7	89.5	91.0	91.7	90.2
15	91.7	93.0	90.2	91.7	92.4	91.0

- C. Efficiency: NEMA Premium
- D. Stator: Copper windings, unless otherwise indicated.

- E. Rotor: Squirrel cage, unless otherwise indicated.
- F. Bearings: Double-shielded, pre-lubricated ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating, unless otherwise indicated.
- H. Insulation: Class F, unless otherwise indicated.
- I. Code Letter Designation: NEMA starting Code F or G.
- J. Enclosure: Cast iron.
- K. Finish: Gray enamel.
- L. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- M. Motors Used with Variable Speed Drives: 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. Premium Efficiency 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.
 - 5. Motors less than 1 hp shall be ODP or TEFC. Motors over 1 hp shall be TEFC.
 - 6. Shaft Grounding: Provide AEGIS bearing protection ring or approved equal.
 - a. All motors operated on variable frequency drives shall be equipped with a maintenance free, conductive micro fiber, shaft grounding ring with a minimum of two rows of circumferential micro fibers to discharge electrical shaft currents within the motor and/or its bearings.
 - b. Motors up to 100 HP shall be provided with a minimum of one shaft grounding ring installed either on the drive end or non-drive end. Motors over 100 HP shall be provided with an insulated bearing on the non-drive end and a shaft grounding ring on the drive end of the motor.
 - c. Grounding rings shall be provided and installed by the motor manufacturer in accordance with the shaft grounding ring manufacturer's recommendations.
- N. Source Quality Control: Perform the following tests on each motor according to NEMA MG 1:
 - 1. Measure winding resistance.
 - 2. Read no-load current and speed at rated voltage and frequency.
 - 3. Measure locked rotor current at rated frequency.
 - 4. Perform high-potential test.

2.4 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. Split Phase.
 3. Capacitor start, inductor run.
 4. Capacitor start, capacitor run.
- B. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- C. Motors 1/20 HP and Smaller: Shaded-pole type.
- D. 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

3.1 FIELD QUALITY CONTROL

- A. Perform the following:
1. Run each motor with its controller at load.
 2. Demonstrate correct rotation, alignment, and speed.
 3. Test interlocks and control features for proper operation.
 4. Verify that current in each phase is within nameplate rating.
 5. Verify RPM is in accordance with nameplate.
 6. Where a generator is provided, run each motor on the generator with its controller and load. Demonstrate correct rotation, alignment, and speed.

3.2 ADJUSTING

- A. Align motors, bases, and shafts.

3.3 CLEANING

- A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

END OF SECTION 230513

SECTION 230523 – GENERAL DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

- A. The following are standard abbreviations for valves:
 - 1. CWP: Cold working pressure.
 - 2. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 3. MPDTE: Modified polytetrafluoroethylene plastic.
 - 4. NBR: Acrylonitrile-butadiene rubber.
 - 5. PTFE: Polytetrafluoroethylene plastic.
 - 6. RPTFE: Reinforced polytetrafluoroethylene plastic.
 - 7. SWP: Steam working pressure.
 - 8. TFE: Tetrafluoroethylene plastic.
 - 9. WOG: Water Oil Gas.

1.3 SUBMITTALS

- A. Product Data: For each type of valve proposed. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include proposed specialties and accessories.

1.4 QUALITY ASSURANCE

- A. ASME Compliance: ASME B31.1 for power piping valves and ASME B31.9 for building services piping valves.
 - 1. Exceptions: Domestic hot- and cold-water valves unless referenced.
- B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set ball valves open to minimize exposure of functional surfaces.
 - 4. Set butterfly valves closed or slightly open.

- 5. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 VALVES, GENERAL

- A. Refer to Part 3 "Valve Applications" Article for applications of valves.
- B. Bronze & Brass: Shall be dezincification resistant. (Zinc content shall be less than 15%)
- C. Bronze Valves: 2" and smaller with threaded ends, unless otherwise indicated.
- D. Ferrous Valves: 2-1/2" and larger with flanged ends, unless otherwise indicated.
- E. Valve Pressure and Temperature Ratings: Not less than indicated for system pressure and temperature.
- F. Valve Sizes: Same as the larger of the upstream or downstream pipe, unless otherwise indicated.
- G. Valve Actuators:
 - 1. As indicated in other Part 2 articles.
 - 2. Where indicated, provide a chain actuator.
 - 3. Chain Actuator: For attachment to valves of size and mounting height indicated.
 - 4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.
- H. Extended Valve Stems: Provide on insulated valves.
- I. Valve Flanges: Provide ASME B16.1 for cast-iron valves, ASME B16.5 for steel, and ASME B16.24 for bronze.
- J. Valve Grooved Ends: AWWA C606.
- K. Threaded: With threads according to ASME B1.20.1.
- L. Valve Bypass and Drain Connections: MSS SP-45.

2.2 COPPER-ALLOY BALL VALVES

- A. Two-Piece, Copper-Alloy Ball Valves (Full Port):
1. Conbraco Industries-Apollo 77C-140 Series with stainless steel ball & stem (Un-insulated piping)
 2. Conbraco Industries-Apollo 77C-140 Series with stainless steel ball & stem. Provide 2 ¼" stem extension (Insulated piping)
 3. Other Manufacturers:
 - a. Crane Co.; Crane Valve Group.
 - b. Grinnell Corporation.
 - c. Nibco.
 4. Handle Nut: Zinc plated steel or 300 series stainless steel.
 5. Handle: Zinc plated steel, clear chromate plastic, or vinyl coated.
 6. Threaded Pack Gland: Brass ASTM B-16 Alloy 360
 7. Packing: MPTFE or TFE
 8. Stem (Blowout Proof): ASTM A-276 type 316 stainless steel. Provide 2 ¼" stem extension for Insulated piping.
 9. Thrust Washer: MPTFE or RPTFE
 10. Ball: Full-port, ASTM A-276 Type 316 stainless steel.
 11. Seats: MPTFE or Reinforced TFE
 12. Body: Bronze ASTM B-584 for solder or threaded connection.
 13. Body End Piece: Bronze ASTM B-584 for solder or threaded connection.
 14. Rating: 150 psig saturated steam, 600 psig non-shock cold water, oil, and gas.
 15. Conform To: MSS SP-110

2.3 FERROUS-ALLOY BUTTERFLY VALVES

- A. Class 150, Single-Flange, High-Performance Butterfly Valves:
1. Manufacturers:
 - a. Crane Co.; Crane Valve Group.
 - b. Grinnell Corporation.
 - c. Hammond Valve.
 - d. Nibco.
 2. CWP Rating: 285 psig at 100 deg F.
 3. Body Design: Threaded Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 4. Body: Carbon Steel, cast iron, ductile iron, or stainless steel.
 5. Standard: MSS SP-68.
 6. Disc: Carbon Steel.
 7. Stem: Type 300 or 400 series stainless steel, one piece, and shall utilize an internal connection to the disc via a double D drive. Provide blow-out proof stem in accordance with API 609.
 8. Seat: Reinforced PTFE or metal.
 9. Service: Bidirectional.

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 indicated.
- 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 chainwheels on operators for ball and butterfly valves 4" and larger and more than 96 inches above finished floor. Extend chains to 60 inches above finished floor.
- F. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.
- G. Where applicable, install an isolation valve on supply and return piping at each branch from a vertical riser to each floor served. Locate floor isolation valves in an accessible location. Multiple sets on one floor may be required to provide accessibility.
- H. Where combination valves are installed, provide shut-off valves on each side of combination valves.

3.3 ADJUSTING

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

3.4 VALVE APPLICATIONS

- A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball or butterfly valves.
 - 2. Throttling Service: Ball or butterfly valves.
 - 3. Pump Discharge: Spring-loaded, lift-disc check valves and ball or butterfly valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
- C. Chilled-Water and Heating Hot Water Piping (Use the following types of valves):
 - 1. Valves, NPS 3" and Smaller: Two-Piece, Copper-Alloy Ball Valves (Full Port).
 - 2. Valves, NPS 4" and Larger: Wafer-Lug, grooved-end, or flanged butterfly valves.

END OF SECTION 230523

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.
- B. Terminology as defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

- A. Design Requirement: Design pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer where using methods other than indicated.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test medium.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 - 3. Design seismic-restraint hangers and supports for piping and equipment.

1.4 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pre-galvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

C. Metal Framing Systems:

1. Available Manufacturers:
 - a. Anvil International; a subsidiary of Mueller Water Products Inc.
 - b. Empire Industries, Inc.
 - c. ERICO International Corporation.
 - d. Haydon Corporation; H-Strut Division.
 - e. NIBCO INC.
 - f. PHD Manufacturing, Inc.
 - g. PHS Industries, Inc.
2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4.
4. Channels: Continuous slotted steel channel with inturred lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Coating: Zinc.

2.2 THERMAL-HANGER SHIELD INSERTS

A. Available Manufacturers:

1. Carpenter & Paterson, Inc.
2. Clement Support Services.
3. ERICO International Corporation.
4. National Pipe Hanger Corporation.
5. PHS Industries, Inc.
6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.

7. Piping Technology & Products, Inc.
 8. Rilco Manufacturing Co., Inc.
 9. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig, ASTM C 552, Type II cellular glass with 100-psig, or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2" beyond sheet metal shield for piping operating below ambient air temperature.

2.3 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
1. Available Manufacturers:
 - a. Cooper B-Line – Dura-Blok
 - b. MAPA Products
 - c. Mifab, Inc. – C-Port
 - d. Miro Industries, Inc.
 - e. OMG, Inc.
 - f. PHP Systems/Design
 - g. Pipe Prop
 - h. Roof Top Blox
 - i. Rooftop Support Systems – Eberl Iron Works, Inc.
 2. Provide pipe supports for supporting gas, condensate, refrigeration lines, or hydronic piping on flat roof surfaces. Support shall rest on roof surface without penetrating the roof surface. Supports for condensate piping shall be adjustable vertically to ensure pipe slopes as required.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Curb Mounted Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.4 EQUIPMENT SUPPORTS/RAILS

- A. Description: Welded, shop or field fabricated equipment support made from structural carbon-steel shapes unless indicated otherwise.

1. Available Manufacturers:
 - a. Curbs Plus, Inc. – CPES-X
 - b. Kees – Equipment Support Model SF
 - c. Pate Company – Equipment Support ES-2
 - d. Portals Plus – ER-2A
 - e. Roof Products and Systems – Equipment Rails ER-2B
 - f. Thybar Corporation – TEMS 3
2. Construction:
 - a. Minimum 18 gauge, G90 galvanized steel. Fully mitered and welded corners. Integral base plate. 3” Cant style support. All welds prime painted after fabrication. Full-depth internal C-channel reinforcing on 12” centers and 6” spreader channels on alternating 12” centers. 18 Gauge counterflashing factory-installed with tek-screws and neoprene washers. Factory-installed 2’x4” pressure-treated wood nailer.
 - b. Minimum height of 12” above finished roof or as noted.

2.5 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and nonmetallic grout; suitable for interior and exterior applications.
 1. Properties: Non-staining, noncorrosive, and nongaseous.
 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Provide hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- C. Thermal-Hanger Shield Installation: Provide in pipe hanger or shield for insulated piping.
- D. Pipe Stand Installation:
 1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Division 07 Section "Roof Accessories" for curbs.
- E. Provide hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- G. Provide hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- H. Provide lateral bracing with pipe hangers and supports to prevent swaying.
- I. Provide building attachments within concrete slabs or attach to structural steel. Building attachments may not used on steel joists unless otherwise indicated. Provide additional attachments at concentrated loads, including valves, flanges, and strainers, 2-1/2" and larger and at changes in direction of piping. Provide concrete inserts before concrete is placed; fasten inserts to forms and provide reinforcing bars through openings at top of inserts.
- J. Load Distribution: Provide hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- K. Pipe Slopes: Provide hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- L. Insulated Piping:
 1. Attach clamps and spacers to piping.
 - a. Provide thermal-hanger shield insert with clamp sized to match OD of insert.
 - b. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 2. Provide MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 3. Provide MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 4. Shield Dimensions for Pipe: Not less than the following:
 - a. Pipe 1/4" to 3-1/2": 12 inches long and 0.048 inch thick.
 - b. Pipe 4": 12 inches long and 0.06 inch thick.
 - c. Pipe 5" and 6": 18 inches long and 0.06 inch thick.
 - d. Pipe 8" to 14": 24 inches long and 0.075 inch thick.
 5. Pipes 8" and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
 6. Thermal-Hanger Shields: Provide with insulation same thickness as piping insulation.

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 bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 ROOF EQUIPMENT SUPPORTS

- A. Equipment supports must span a minimum of two structural roof members.
- B. No load shall be applied to a cantilever exceeding 12" in length.
- C. Fasten base flange to roof steel or deck with stitch weld or mechanical fastener not exceeding 18" on center in accordance with NRCA specifications.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Provide 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 so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

- A. Touchup: Unless otherwise indicated clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Provide 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 a minimum dry film thickness of 2.0 mils.

- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and immediately apply galvanizing-repair paint. Paint shall comply with ASTM A 780.

3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Provide hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Provide nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Provide copper-plated pipe hangers and copper attachments for copper piping and tubing.
- F. Provide padded hangers for piping that is subject to scratching.
- G. Provide thermal-hanger shield inserts for insulated piping and tubing.
- H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated provide the following:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of stationary pipes ½" to 30".
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F pipes 4" to 14", requiring up to 4" of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes ¾" to 14", requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes ½" to 14" if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes ½" to 4", to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes ¾" to 8".
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes ½" to 8".
 - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes ½" to 8".
 - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes ½" to 8".
 - 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes ½" to 8".
 - 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS ½" to 3".
 - 12. U-Bolts (MSS Type 24): For support of heavy pipes ½" to 14".

13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 14. Pipe Saddle Supports (MSS Type 36): For support of pipes 4" to 14", with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes 4" to 14", with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes 2-½" to 14" if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
 17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes 1" to 14", from two rods if longitudinal movement caused by expansion and contraction might occur.
 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes 2-½" to 14", from single rod if horizontal movement caused by expansion and contraction might occur.
 19. Complete Pipe Rolls (MSS Type 44): For support of pipes 2" to 14" if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes 2" to 14" if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes 2" to 14" if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- I. Vertical-Piping Clamps: Unless otherwise indicated provide the following:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers ¾" to 14".
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers ¾" to 14" if longer ends are required for riser clamps.
- J. Hanger-Rod Attachments: Unless otherwise indicated provide the following:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
 6. Flat Plate, Double Nut, and Washer as Detailed on Structural Drawings: For attaching to bar joists. Method of attachment to bar joists must be approved by the structural engineer and joist manufacturer.
- K. Building Attachments: Unless otherwise indicated provide the following:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Flat Plate, Double Nuts, and Washer as Detailed on Structural Drawings: For use under roof installations with bar-joist construction to attach to bottom chord of joist.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.

4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For steel I-beams. Only allowed for open web joists if load does not exceed 50 lbs.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Provide one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
 16. For sloping structure, provide clamp with swivel such that required threaded rod is vertical. Bending of threaded rod is not acceptable.
- L. Saddles and Shields: Unless otherwise indicated provide the followings:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- M. Spring Hangers and Supports: Unless otherwise indicated provide the following:
1. Restraint-Control Devices (MSS Type 47): To control pipe movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.

- 7. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
- N. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- O. Provide powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where indicated in concrete construction.

END OF SECTION 230529

SECTION 230548 - VIBRATION CONTROL FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning & Development for the State of California.
- D. ASCE: American Society of Civil Engineers

1.3 RESPONSIBILITIES:

- A. The manufacturer of vibration isolation systems and devices shall:
 - 1. Determine the sizes and locations of isolators and provide equipment isolation as indicated.
 - 2. Guarantee indicated isolation system deflections.
 - 3. Provide installation instructions and drawings.
 - 4. Certify correctness of installation upon completion.
- B. The Contractor shall cause all vibration isolation systems, including the isolators, and flexible connectors between the isolated equipment and associated piping, ducting, and electrical work to be designed by a manufacturer experienced in this type of work.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Wind-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of wind restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Coordinate vibration isolation details with wind-restraint details required for equipment mounted outdoors.
- B. Coordination Drawings: For areas indicated at $\frac{1}{4}" = 1'0"$ and where sections are cut on contract drawings, indicate coordination of HVAC piping and equipment with other systems and equipment in the vicinity, include supports and restraints.
- C. Qualification Data: For testing agency.

D. Shop Drawings:

1. Dimensioned Outline Drawings for Each Scheduled Piece of Equipment: Identify center of gravity.
2. Dimensioned Outline Drawings for Each Scheduled Piece of Equipment: Locate and describe mounting and anchorage provisions.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Available Manufacturers:

1. Amber/Booth Company, Inc.
2. B-Line Systems, Inc.
3. Kinetics Noise Control.
4. Mason Industries.
5. Vibration Mountings & Controls, Inc.
6. Vibro-Acoustics, Inc.

B. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

C. Elastomeric Hangers: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

2.2 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 - 1. Powder coating on springs and housings.
 - 2. All hardware shall be galvanized. Hot-dip-galvanize metal components for exterior use.
 - 3. Bake enamel or powder coat for metal components on isolators for interior use.
 - 4. Color-code or otherwise mark vibration isolation and wind control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Strength of Support and Wind Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to resist loads within loading limits.

3.3 VIBRATION-CONTROL DEVICE INSTALLATION

- A. Comply with requirements indicated in the Contract Documents, in codes and ordinances, by Authority Having Jurisdiction, and by Manufacturer, for installation of all devices.

3.4 FIELD QUALITY CONTROL

- A. Perform tests.
- B. Tests:
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.

3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least two of each type and size of installed anchors and fasteners.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.
9. If a device fails test, fix and retest until satisfactory results are achieved then modify all installations of same type to match.

C. Prepare test reports.

3.5 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.6 VIBRATION ISOLATION SCHEDULE

A. Piping and Conduit

1. All piping and conduit connected to pumps, air handling units, or other pieces of moving equipment which are isolated from the structure by spring type vibration isolators shall be isolated from these units by flexible pipe connectors and shall be suspended on isolation hangers to a point 20 feet away. Refer to Section "Hydronic Piping" for flexible pipe connectors.
2. Provide spring hangers with 1/2" deflection for suspended piping.
3. Provide spring isolators with 1/2" deflection for floor-mounted piping.

B. Ductwork

1. Flexible connectors shall be used for ductwork connections to air handling units. Refer to Section "Metal Duct Accessories." Ductwork shall be suspended with elastomeric hangers for a distance of 20 feet from air handling units.

C. Power Ventilators

1. Provide spring hangers for units suspended from structure above ceiling.

END OF SECTION

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment nameplates.
 - 2. Equipment markers.
 - 3. Warning signs and labels.
 - 4. Pipe labels.
 - 5. Duct labels.
 - 6. Valve tags.
 - 7. Warning tags.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 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.

1.5 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 LABELS

- 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, color-coded laminated plastic. Include contact-type, permanent adhesive.
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8-inch-thick with predrilled holes for attachment hardware.
 - 2. Letter Color: White or black.
 - 3. Background Color: Black or white.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Access Panel and Door Markers: 1/16-inch-thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification.
 - 1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.
- D. Label Content: Include equipment's drawing designation (tag) with unique equipment number as scheduled.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8-inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White or black.

- C. Background Color: Black or white.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include equipment's drawing designation (tag) with unique equipment number as scheduled. Include caution and warning information plus emergency notification instructions.

2.3 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door markers, equipment markers, equipment signs, and similar operational instructions.
 - 1. Stencil Material: Metal or fiberboard.
 - 2. Stencil Paint: Exterior, gloss, black, unless otherwise indicated. Paint shall be low VOC and shall meet the requirements of section 09910. Paint may be in pressurized spray-can form.
 - 3. Identification Paint: Exterior, in colors according to ASME A13.1, unless otherwise indicated. Paint shall be low VOC.

2.4 DUCT LABELS

- A. Material and Thickness: Self-adhesive duct labels with 2.5-mil clear laminate coating that is UV, chemical, abrasion, and moisture resistant. Provide UV-stable ink suitable for indoor or outdoor use. Colors shall conform to ANSI Z535.1.
- B. Letter Color: White.
- C. Background Color: Green.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater

viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

- G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- H. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.

2.5 VALVE TAGS

- A. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.032-inch stainless steel, 0.025-inch aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link chain or beaded chain or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 VALVE SCHEDULES

- A. Valve Schedules: For each piping system, on standard-size bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
 - 2. Frame: Finished hardwood or extruded aluminum.
 - 3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.7 WARNING TAGS

- A. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
 - 1. Size: 3 by 5-1/4 inches minimum.
 - 2. Fasteners: Reinforced grommet and wire or string.

- 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
- 4. Color: Safety-yellow background with black lettering.

2.8 ACOUSTICAL CEILING GRID MARKER

- A. General: Plastic tape a minimum of three one-thousandths of an inch thick (3.0 mils) with pressure-sensitive, permanent-type, self-adhesive back.
- B. Width: three quarters of an inch (3/4") or 22 millimeters.
- C. Letter Size: 1/4" minimum or 8 millimeters.
- D. Letter Color: Black
- E. Tape Color: White.

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 GENERAL INSTALLATION REQUIREMENTS

- 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 locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

- A. Piping Color Coding: Painting piping colors as indicated in Wake County Standards. Pipe colors shall be in accordance with the following schedule:
 - 1. Hot Water Supply & Return Piping: Light Red

2. Chilled Water Supply & Return Piping: Light Blue

- B. Pipe Label Locations: 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. 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 and on both sides of through walls, floors, ceilings, and inaccessible 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 along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings, omit intermediately spaced labels.
- C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- D. Pipe Label Color Schedule:
1. Chilled-Water Piping: White letters on a safety-green background.
 2. Heating Water Piping: Black letters on a yellow background.
 3. Refrigerant Piping: Black letters on a safety-orange background.

3.5 DUCT LABEL INSTALLATION

- A. Install duct markers with permanent adhesive on air ducts in colors complying with ASME A13.1.
- B. Install plastic-laminated or self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
1. Blue: For cold-air supply ducts.
 2. Yellow: For hot-air supply ducts.
 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
- C. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.6 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose

connections, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

- a. Chilled Water: 1-1/2 inches, round.
- b. Condenser Water: 1-1/2 inches, round.
- c. Refrigerant: 1-1/2 inches, round.
- d. Hot Water: 1-1/2 inches, round.
- e. Gas: 1-1/2 inches, round.
- f. Low-Pressure Steam: 1-1/2 inches, round.
- g. High-Pressure Steam: 1-1/2 inches, round.
- h. Steam Condensate: 1-1/2 inches, round.

2. Valve-Tag Colors:

- a. Toxic and Corrosive Fluids: Black letters on a safety-orange background.
- b. Flammable Fluids: Black letters on a safety-yellow background.
- c. Combustible Fluids: White letters on a safety-brown background.
- d. Potable and Other Water: White letters on a safety-green background.
- e. Compressed Air: White letters on a safety-blue background.
- f. Defined by User: White letters on a safety-purple background, black letters on a safety-white background, white letters on a safety-gray background, and white letters on a safety-black background

3.7 FIRE AND SMOKE DAMPERS

- A. Access points for fire, smoke and fire-smoke dampers shall be permanently identified on the exterior of the duct by a label or sign with letters not less than 1" in height reading: "FIRE/SMOKE DAMPER, SMOKE DAMPER, or FIRE DAMPER."

3.8 ACOUSTICAL CEILING GRID MARKER INSTALLATION

- A. Attach tape with indicated text to t-bar below item of equipment.
- B. Attach tape to grid.
- C. Prepare surface and attach tape in accordance with manufacturer's recommendations.
- D. Surfaces to receive tape shall be clean and free of scale, dirt, and grease.
- E. Center tape on support grid. Tape shall be visible from within space.
- F. Provide with lettering at equipment located above lay-in tile ceilings including but not limited to:
 - 1. Valves: Text = V

2. Air Handling Units: Text = AHU
3. Air Removal Devices: Text = ARD
4. Strainers: Text = S
5. Terminal Units (VAV boxes): Text = TU
6. Fan Coil Units: Text = FCU
7. Blower Coils: Text = BC
8. Coils: Text = C
9. Heat Pumps: Text = HP
10. Cabinet Unit Heaters: Text = CUH
11. Fans: Text = F
12. Damper operators: Text = D

3.9 VALVE-SCHEDULE INSTALLATION

- A. Mount valve schedule on wall in accessible location in each major equipment room.

3.10 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

3.11 ADJUSTING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.12 CLEANING

- A. Clean faces of mechanical identification devices and glass fronts of valve schedules.

END OF SECTION 230553

SECTION 230700 - HVAC INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

- A. Outdoor duct and pipe: Duct conveying untreated outside air at ambient temperature and humidity.
- B. Outdoor pipe: Pipe located outside the building insulation envelope.
- C. Supply air duct: Duct conveying air on the discharge side of an air handling unit or fan which will be delivered to a space in a building through a diffuser or connection to the return duct of another unit. Ductwork on the discharge side of a 100% outside air unit is considered to be Supply air duct.
- D. Return air duct: Duct conveying air from a space or plenum that will return to an air handling unit or energy transfer device. The air may be returned to the supply air duct after being conditioned, or it may be exhausted after passing through an energy transfer device. Typical examples of an energy transfer devices are plate heat exchangers, runaround coils, heat pipes, and energy wheels.
- E. Exhaust air duct: Duct conveying air from a space or plenum that will be exhausted from the building without being passed through an energy transfer device.
- F. Plenum: An unoccupied space or void, on the conditioned side of the building insulation and vapor barrier, being used to return conditioned air to the inlet side of a return or exhaust fan either directly or via a duct connection. An example would be a space with air handling light fixtures or openings in the ceiling used to transport air through the ceiling and then to an open duct located above the ceiling in another location.
- G. Indirectly Conditioned Space: A space having no direct conditioning but, due to air movement induced by an exhaust, or return opening, is conditioned by makeup air from an adjacent space. An example would be a small toilet. Boiler rooms, fan rooms, and mechanical rooms do not qualify as indirectly conditioned spaces.
- H. Inside the Building Insulation Envelope: For the purposes of this section, boiler rooms, fan rooms, and mechanical rooms are considered to be OUTSIDE the building insulation envelope.

1.3 SUBMITTALS

- A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for the following:
 - 1. Detail application of removable insulation covers.
 - 2. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 3. Detail attachment and covering of heat tracing inside insulation.

4. Detail insulation application at pipe expansion joints for each type of insulation.
5. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
6. Detail removable insulation at piping specialties, equipment connections, and access panels.
7. Detail application of field-applied jackets.
8. Detail application at linkages of control devices.
9. Detail field application for each equipment type.

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.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Ship insulation materials in containers marked by manufacturer with type, grade, and maximum use temperature.
- B. Ship Insulated Piping System Components on pallets and wood supports. Securely fasten and protect from damage. Store off the ground and cover with opaque waterproof tarp to protect materials from sunlight and rain.

1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation, duct Installer for duct insulation, and equipment Installer for equipment insulation.
- C. Maintain clearances required for maintenance.
- D. Coordinate installation and testing of heat tracing.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers:
 1. Mineral-Fiber Insulation:
 - a. CertainTeed Corporation.
 - b. Johns Manville.
 - c. Knauf Insulation.

- d. Owens Corning.
- 2. Flexible Elastomeric Thermal Insulation:
 - a. Aeroflex USA, Inc.
 - b. Armacell, LLC.
 - c. K-Flex USA.
 - d. Rubatex Corp.
- B. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- C. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- D. 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.
- E. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- F. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- G. Duct Liner: Refer to specification section "Metal Ducts"
- H. Mineral-Fiber Board: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB, with factory applied FSK Jacket. Meet the requirements of ASTM C 1290, Type III, inorganic glass fibers bonded by a thermosetting resin to maximum service temperature of 250°F. Faced insulation shall not exceed 25 Flame Spread, 50 Smoke Developed when tested in accordance with ASTM E84.
- I. Semi-Rigid Mineral-Fiber Board: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 1136, Type I, II, III, & IV with factory applied all-service jacket (ASJ) or Type II, IV with factory applied Foil Scrim Kraft (FSK) jacket.
- J. Mineral-Fiber Blanket Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III, without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.
- K. Mineral-Fiber Pipe Insulation: Glass fibers bonded with a thermosetting resin complying with the following:
 - 1. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket.
 - 2. Semi-Rigid Mineral-Fiber Board: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 1136, Type I, II, III, IV with factory applied all-service jacket (ASJ) or Type II, IV with factory applied Foil Scrim Kraft (FSK) jacket.
 - 3. Blanket Insulation: Comply with ASTM C 553, Type II, without facing.
 - 4. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:
 - a. Class 1, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.
 - b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.

5. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.
 6. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
 7. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C 196.
 8. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
- L. 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. Adhesive: As recommended by insulation material manufacturer.
 2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.
- M. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

2.2 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-SSL: ASJ with self-sealing pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.3 FIELD-APPLIED JACKETS

- A. General: ASTM C 921, Type 1, unless otherwise indicated.
- B. Glass Cloth: Woven glass-fiber fabric, plain weave, minimum 8 ounces per square yard.
- C. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.
- D. Aluminum Jacket: Deep corrugated sheets manufactured from aluminum alloy complying with ASTM B 209, and having an integrally bonded moisture barrier over entire surface in contact with insulation. Factory cut and rolled to indicated sizes. Comply with ASTM B 209, 3003 alloy, H-14 temper.
1. Finish and Thickness: Stucco-embossed finish, 0.016 inch thick.
 2. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and kraft paper.
 3. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, finish, and thickness as jacket.

2.4 REMOVABLE INSULATION COVERS

- A. Pre-manufactured easily removable insulation cover/blanket intended for insulation of equipment and devices requiring periodic maintenance.
- B. For chilled water pumps, provide min 22-gauge stainless steel box around suction diffuser and pump housing with 2" thick close cell elastomeric insulation liner adhered to inside of box. The box shall be designed to be in two (2) halves with latching clips/ latches for easy removal and re-installation. Where the two halves come together, there should be gasketing material for tight seal and along base. Alternative acceptable approaches are the use of pump insulation covers manufactured by Fit Tight Covers design for removable pump insulation covers.

2.5 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz./sq. yd..
 - 1. Tape Width: 4 inches.
- B. Bands: 3/4 inch wide, in one of the following materials compatible with jacket:
 - 1. Stainless Steel: ASTM A 666, Type 304; 0.020 inch thick.
 - 2. Galvanized Steel: 0.005 inch thick.
 - 3. Aluminum: 0.007 inch thick.
 - 4. Brass: 0.010 inch thick.
 - 5. Nickel-Copper Alloy: 0.005 inch thick.
- C. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel.
- D. Weld-Attached Anchor Pins and Washers: Copper-coated steel pin for capacitor-discharge welding and galvanized speed washer. Pin length sufficient for insulation thickness indicated.
 - 1. Welded Pin Holding Capacity: 100 lb for direct pull perpendicular to the attached surface.
- E. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct, pipe, plenum and breeching with adhesive. Pin length sufficient for insulation thickness indicated.
 - 1. Adhesive: Recommended by the anchor pin manufacturer as appropriate for surface temperatures of ducts, pipes, plenums, and breechings; and to achieve a holding capacity of 100 lb. for direct pull perpendicular to the adhered surface.
- F. Self-Adhesive Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct, pipe, and plenum with adhesive. Pin length sufficient for insulation thickness indicated.

2.6 VAPOR RETARDERS

- A. Mastics: Materials that are compatible with insulation materials, jackets, and substrates.

2.7 REMOVABLE INSULATION COVERS

- A. Pre-manufactured easily removable insulation cover/blanket intended for insulation of equipment and devices requiring periodic maintenance.

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.
- B. 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.

3.3 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of ducts, piping, and fittings.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thickness required for each system.
- C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Apply multiple layers of insulation with longitudinal and end seams staggered.
- E. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- F. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- G. Keep insulation materials dry at all times. Insulation that becomes wet or is otherwise damaged beyond repair, shall be removed immediately and replaced. Replacement material and installation shall be in accordance with these specifications.
- H. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- I. Apply insulation with the minimum number of joints practical.
- J. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
- K. Refer to special instructions for applying insulation over fittings, valves, and specialties.
- L. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
 - 1. Apply insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
 - 3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.
- M. Insulation Terminations: For insulation application where vapor retarders are indicated, seal ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

- N. Apply insulation with integral jackets as follows:
 - 1. Pull jacket tight and smooth.
 - 2. Joints and Seams: Cover with tape and vapor retarder to maintain vapor seal.
 - 3. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to duct flanges, pipe joints, and fittings.
- O. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.
- P. Install vapor-retarder mastic on ducts, pipes, plenums, and equipment.
 - 1. Ducts, pipes, plenums, and equipment with Vapor Retarders: Overlap insulation facing at seams and seal with vapor-retarder mastic and pressure-sensitive tape having same facing as insulation. Repair punctures, tears, and penetrations with tape and mastic to maintain vapor-retarder seal.
 - 2. Ducts, pipes, plenums, and equipment without Vapor Retarders: Overlap insulation facing at seams and secure with outward clinching staples and pressure-sensitive tape having same facing as insulation.
- Q. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
 - 1. Seal penetrations with vapor-retarder mastic.
 - 2. Apply insulation for exterior applications tightly joined to interior insulation ends.
 - 3. Seal insulation to roof flashing with vapor-retarder mastic.
- R. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.
- S. Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire/smoke damper sleeves for fire-rated wall and partition penetrations.
- T. Floor Penetrations: Terminate insulation at underside of floor assembly and at floor support at top of floor.
 - 1. For insulation indicated to have vapor retarders, taper termination and seal insulation ends with vapor-retarder mastic.

3.4 MINERAL-FIBER INSULATION APPLICATION

- A. Blanket Applications for Ducts, Pipes, and Plenums: Secure blanket insulation with adhesive, and anchor pins with speed washers.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of duct, pipe, and plenum surfaces.
 - 2. Apply adhesive to entire circumference of ducts & pipes and to all surfaces of fittings and transitions. Adhesive may be omitted from the top of horizontal rectangular ducts.
 - 3. Install anchor pins and speed washers on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.

- b. On duct sides with dimensions larger than 18 inches. Space 16 inches o.c. each way, and 3 inches maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.
 - c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not compress insulation to less than 75% of its original thickness during installation.
 - 4. Install anchor pins and speed washers on sides, top, and bottom of horizontal pipes.
 - 5. Impale insulation over anchors and attach speed washers.
 - 6. Cut excess portion of pins extending beyond speed washers. Cover exposed pins and washers with tape matching insulation facing.
 - 7. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch staples, 1-inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
 - 8. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. Secure with steel band at end joints and spaced a maximum of 18 inches o.c.
 - 9. Apply insulation on rectangular duct elbows, pipe fittings, and transitions with a full insulation segment for each surface. Apply insulation on round and flat-oval duct elbows, and pipe elbows, with individually mitered gores cut to fit the elbow.
 - 10. Insulate duct and pipe stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6-inch- wide strips of the same material as insulation. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.
 - 11. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.
- B. Board Applications for Ducts, Plenums, & Equipment: Secure board insulation with adhesive and anchor pins and speed washers.
- 1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of duct, plenum, & equipment surfaces.
 - 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings, transitions, and equipment. Adhesive may be omitted from top surface of horizontal rectangular ducts.
 - 3. Space anchor pins as follows:
 - a. On duct & equipment sides with dimensions 18 inches and smaller, along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct & equipment sides with dimensions larger than 18 inches. Space 16 inches o.c. each way, and 3 inches maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at bracing.
 - c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not compress insulation to less than 75% of its original thickness during installation.
 - 4. Cut excess portion of pins extending beyond speed washers. Cover exposed pins and washers with tape matching insulation facing.

5. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch staples, 1-inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
6. Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Apply insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct and equipment stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6" wide strips of the insulating material. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.
8. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

3.5 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

- A. Apply insulation to ducts, plenums, and equipment as follows:
 1. Follow the manufacturer's written instructions for applying insulation.
 2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the duct, plenum, and equipment surface.

3.6 FIELD-APPLIED JACKET APPLICATION

- A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.
 1. Apply jacket smooth and tight to surface with 2-inch overlap at seams and joints.
 2. Embed glass cloth between two 0.062-inch-thick coats of jacket manufacturer's recommended adhesive.
 3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.

3.7 FINISHES

- A. Glass-Cloth Jacketed Insulation: Paint insulation finished with glass-cloth jacket as specified in Division 9 Section "Paints."
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color shall be as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

3.8 DIFFUSER APPLICATIONS

- A. Insulate exposed metal surfaces on top of all supply diffusers. Where diffusers are mounted in a metal pan, insulate the top of the pan.
 1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
 2. Thickness: 1 inch.
 3. Vapor Retarder Required: Yes.
- B. Insulate slot diffuser plenums where uninsulated plenums are provided.

3.9 APPLICATIONS

- A. Insulation materials and thickness are specified at the end of this Section.
- B. Insulate all ductwork, pipe and equipment:
 - 1. Insulate ductwork in accordance with the application schedule(s) below.
 - 2. Exceptions: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
 - a. Vibration-control devices.
 - b. Testing agency labels and stamps.
 - c. Nameplates and data plates.
 - d. Manholes.
 - e. Handholes.
 - f. Cleanouts.
 - g. Plastic condensate drain piping.
 - h. Pipe-mounted condensate sensors.
 - i. Exhaust ductwork.
 - 1) Exception: Duct beginning 18" upstream of backdraft damper and continuing to building envelope insulation.
 - j. Metal ducts with duct liner.
 - k. Factory-insulated flexible ducts.
 - l. Factory-insulated plenums, casings, terminal boxes, and filter boxes and sections.
 - m. Flexible connectors.
 - n. Access panels and doors in air-distribution systems.
 - o. Ductwork used for smoke control supply and exhaust.

3.10 INDOOR APPLICATION SCHEDULE

- A. Service: Condensate drain piping except plastic.
 - 1. Insulation Material: Mineral fiber preformed pipe insulation.
 - 2. Insulation Thickness: 2"
 - 3. Vapor Retarder Required: Yes.
 - 4. Finish: Finished Spaces = Painted, concealed = Painted.
- B. Service: Round and flat oval, supply-air, return-air, and outside-air ducts concealed and within the building insulation envelope.
 - 1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
 - 2. Thickness: 2 inches.
 - 3. Vapor Retarder Required: Yes.
- C. Service: Rectangular, supply-air, return-air, and outside-air ducts, concealed and within the building insulation envelope.
 - 1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.

2. Thickness: 2 inches.
 3. Vapor Retarder Required: Yes.
 - D. Service: Round and flat oval, supply-air, return-air, and outside-air ducts, exposed.
 1. Material: Semi-Rigid Mineral-Fiber Board with Canvas Jacket.
 2. Thickness: 2 inches.
 3. Vapor Retarder Required: Yes.
 4. Finish:
 - a. Exposed, Finished Spaces: Painted.
 - E. Service: Rectangular, supply-air, return-air, and outside-air ducts, exposed.
 1. Material: Semi-Rigid Mineral-Fiber Board with Canvas Jacket.
 2. Thickness: 2 inches.
 3. Vapor Retarder Required: Yes.
 4. Finish:
 - a. Exposed, Finished Spaces: Painted.
 - F. Service: Chilled water supply and return.
 1. Insulation Material: Cellular Glass pipe insulation.
 2. Insulation Thickness: 2 inches thick
 3. Vapor Retarder Required: Yes.
 4. Finish: Painted.
 - G. Service: Heating hot-water supply and return.
 1. Insulation Material: Mineral fiber preformed pipe insulation.
 2. Insulation Thickness: 2 inches thick.
 3. Vapor Retarder Required: No.
 4. Finish: Painted.
 - H. Refrigerant Suction and Hot-Gas Piping/Tubing:
 1. Insulation Material and Thickness:
 - a. Flexible Elastomeric: 1 inch.
- 3.11 OUTDOOR APPLICATION SCHEDULE
- A. Insulation shall be applied after heat tracing and temperature sensors are in place and have been tested.
 - B. Refrigerant Suction and Hot-Gas Piping:
 1. Insulation Material and Thickness:
 - a. Flexible Elastomeric: 1 inch.
 2. Finish: Two coats of UV coating or mastic protectant recommended by the insulation manufacturer or outdoor aluminum jacket.

END OF SECTION 230700

SECTION 230813 - COMMISSIONING OF MECHANICAL SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. The purpose of this section is to specify the Division 23 contractor responsibilities in the commissioning (Cx) process.
- B. Commissioning requires the participation of the Division 23 contractor to ensure that all systems are operating in a manner consistent with the Contract Documents. The general commissioning requirements and coordination are detailed in Section 019113, General Commissioning Requirements. The Division 23 contractor shall be familiar with all parts of Section 019113 and the Cx Plan issued by the Commissioning Authority (CxA) and shall execute all commissioning responsibilities assigned to them in the Contract Documents.
- C. Section includes Cx process requirements for the following HVAC systems, assemblies, and equipment:
 - 1. Smoke exhaust fans
 - 2. Air handling unit smoke control sequencing
 - 3. Building automation system (associated with the commissioned systems)

1.3 RESPONSIBILITIES

- A. The responsibilities of various parties in the commissioning process, as specifically related to the mechanical systems, are provided in this section.
- B. Refer to Section 019113 and the Cx Plan for all typical commissioning process requirements for each team member.
- C. Refer to Sections 019113 and 014520 for smoke control system commissioning, testing, and inspection requirements.
- D. Each Contractor and subcontractor shall review this Section and shall include in their bids cost for carrying out the work described, as it applies to each Division and Section of these specifications, individually and collectively.
- E. The commissioning responsibilities applicable to each of the mechanical, controls and TAB contractors of Division 23 are as follows (all references apply to commissioned equipment only):

Construction and Acceptance Phases

- 1. Include the cost of commissioning work in the contract price.

2. Attend a commissioning kick-off meeting and other necessary meetings scheduled by the CxA to facilitate the Cx process, as indicated in specification section 019113.
3. Contractors shall provide the CxA with cut sheets and shop drawing submittals of commissioned equipment to the CxA.
4. Provide additional requested documentation, prior to normal O&M manual submittals, to the CxA for development of Pre-Functional Checklists (PFC) and Functional Performance Testing (FPT) procedures.
 - a. Typically, this will include detailed manufacturer installation and startup, operating, troubleshooting and maintenance procedures, full details of any owner-contracted tests, fan and pump curves, full factory testing reports, if any, and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation, startup 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 Agent.
 - b. The CxA may request further documentation necessary for the commissioning process.
5. Provide a copy of the equipment submittals of commissioned equipment, through normal channels, to the CxA for review and comment.
6. Contractors shall assist (along with the design engineers) 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.
7. Provide assistance to the CxA in preparing the specific FPT procedures as specified in the Cx Plan (prepared by the CxA), Section 019113 and this section. Contractor(s) shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.
8. Develop a full startup and initial checkout plan using manufacturer's startup procedures and the Pre-Functional Checklists (PFCs) from the CxA for all commissioned equipment. Submit manufacturer's detailed startup procedures and the full startup plan and procedures and other requested equipment documentation to CxA for review and comment. Refer to Section 019113 for further details on startup plan preparation.
9. During the startup and initial checkout process, execute the mechanical-related portions of the PFCs for all commissioned equipment.
10. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the CxA.
11. Address current A/E punch list items before FPT. Air and water TAB shall be completed with discrepancies and problems remedied. The TAB Report is to be reviewed and approved by the Engineer of Record prior to beginning TAB verification and FPT.
12. Provide skilled technicians to execute starting of equipment and to execute the FPTs. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.
13. Perform FPTs under the direction of the CxA for specified equipment in the Cx Plan, Section 019113 and this Section. Assist the CxA in interpreting the monitoring data, as necessary.
14. Correct deficiencies (differences between specified and observed performance) as interpreted by the CxA, Construction Manager/General Contractor (CM/GC) and A/E and retest the equipment.
15. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.

16. During construction, maintain as-built/record red-line drawings and CAD drawings and provide final record drawings for contractor-generated coordination drawings. Update after completion of commissioning (excluding deferred testing).
17. Provide training of the Owner's operating staff using expert qualified personnel, as specified.
18. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

Warranty Period

1. Execute seasonal or deferred functional performance testing, witnessed by the CxA, according to the specifications.
2. Correct deficiencies and make necessary adjustments to O&M manuals and record drawings for applicable issues identified in any seasonal testing.

F. Mechanical Contractor

Construction and Acceptance Phases

1. Provide startup for all HVAC equipment, except for the building automation control system.
2. Assist and cooperate with the TAB contractor and CxA by:
 - a. Putting all HVAC equipment and systems into operation and continuing the operation during each working day of TAB and commissioning, as required.
 - b. Including cost of sheaves and belts that may be required by TAB.
 - c. Providing test holes in ducts and plenums were directed by TAB to allow air measurements and air balancing. The Division 23 contractor shall provide an approved plug.
 - d. Providing temperature and pressure taps according to the Construction Documents and at each water sensor which is an input point to the control system, for TAB and commissioning testing.
3. List and clearly identify on the as-built drawings the locations of all air-flow stations.
4. Prepare a preliminary schedule for Division 23 pipe and duct system testing, flushing and cleaning, equipment startup and TAB start and completion for use by the CxA. Update the schedule as appropriate.
5. Notify the Owner, CM/GC, or CxA depending on protocol, when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment and TAB will occur. Be responsible to notify the Owner, CM/GC, or CxA, ahead of time, when commissioning activities not yet performed or not yet scheduled will delay construction. Be proactive in seeing that commissioning processes are executed and that the CxA has the scheduling information needed to efficiently execute the commissioning process.

Warranty Period

1. Participate in the near-warranty end (ten month) post occupancy visit.

G. Controls Contractor

Construction and Acceptance Phases

1. Sequences of Operation Submittals. The Controls Contractor's submittals of control drawings shall include complete detailed sequences of operation for each piece of equipment, regardless of the completeness and clarity of the sequences in the specifications. They shall include:
 - a. An overview narrative of the system (1 or 2 paragraphs) generally describing its purpose, components and function.
 - b. All interactions and interlocks with other systems.
 - c. Detailed delineation of control between any packaged controls and the building automation system, listing what points the BAS monitors only and what BAS points are control points and are adjustable.
 - d. Written sequences of control for packaged controlled equipment. (Equipment manufacturers' stock sequences may be included, but will generally require additional narrative).
 - e. Startup sequences.
 - f. Warm-up mode sequences.
 - g. Normal operating mode sequences.
 - h. Unoccupied mode sequences.
 - i. Shutdown sequences.
 - j. Capacity control sequences and equipment staging.
 - k. Temperature and pressure control: setbacks, setups, resets, etc.
 - l. Detailed sequences for all control strategies, e.g., economizer control, optimum start/stop, staging, optimization, demand limiting, etc.
 - m. Effects of power or equipment failure with all standby component functions.
 - n. Sequences for all alarms and emergency shutdowns.
 - o. Seasonal operational differences and recommendations.
 - p. Initial and recommended values for all adjustable settings, set points and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.
 - q. Schedules, if known.
 - r. To facilitate referencing in testing procedures, all sequences shall be written in small statements, each with a number for reference. For a given system, numbers will not repeat for different sequence sections, unless the sections are numbered.
2. Control Drawings Submittal
 - a. The control drawings shall have a key to all abbreviations.
 - b. The control drawings shall contain graphic schematic depictions of the systems and each component.
 - c. The schematics will include the system and component layout of any equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
 - d. Provide a full points list with at least the following included for each point:
 - 1) Controlled system
 - 2) Point abbreviation
 - 3) Point description (e.g., DB temp, airflow, relative humidity, static pressure, etc.)
 - 4) Display unit
 - 5) Control point or set point (Point that controls equipment and can have its set point changed, e.g. OAT, SAT, etc.) (Yes / No)

- 6) Monitoring point (Point that does not control or contribute to the control of equipment, but is used for operation, maintenance, or performance verification) (Yes / No)
 - 7) Intermediate point (Point whose value is used to make a calculation which then controls equipment, e.g. space temperatures that are averaged to a virtual point to control reset) (Yes / No)
 - 8) Calculated point ("Virtual" point generated from calculations of other point values) (Yes / No)
 - 9) Control dead bands and any applicable times for feedback control loops
3. The Controls Contractor shall keep the CxA informed of all changes to this list during programming and setup.
4. An updated as-built version of the control drawings and sequences of operation shall be included in the final controls O&M manual submittal.
5. Assist and cooperate with the TAB contractor in the following manner:
 - a. Meet with the TAB contractor prior to beginning TAB and review the TAB plan to determine the capabilities of the control system toward completing TAB. Provide the TAB any needed unique instruments for setting terminal unit boxes and instruct TAB in their use (handheld control system interface for use around the building during TAB, etc.).
 - b. For a given area, have all required PFCs, calibrations, startup and selected functional tests of the system completed and approved by the CxA prior to TAB.
 - c. Provide a qualified technician to operate the controls to assist the TAB contractor in performing TAB or provide sufficient training for TAB to operate the system without assistance.
6. Sensor and Actuator Calibration:
 - a. All field-installed temperature, relative humidity, CO, CO2 and pressure sensors and gages, and all actuators (dampers and valves) on all equipment shall be field calibrated. Verify that all locations are appropriate and away from causes of erratic operation (i.e. unstable flow conditions, other heat sources, vibration, etc.).
 - b. Verify that the sensor reading (via the permanent thermostat, gage or BAS) is within the tolerances defined in the control's specification section 230900-29 of the instrument-measured value over the full range of expected control. If not, install offset in the BAS, calibrate or replace sensor.
7. Provide a signed and dated certification to the CxA and CM/GC upon completion of the checkout of each controlled device, equipment and system prior to FPT for each piece of equipment or system, that all system programming is complete.
8. Assist and cooperate with the CxA in the following manner:
 - a. Using a skilled technician who is familiar with this building, execute the FPT of the controls system as specified for the controls contractor in the Cx Plan, Section 019113 and this Section. Provide two-way radios during the testing if necessary for communications.
 - b. Execute all control system trend logs specified and as requested by the CxA.
9. List and clearly identify on the as-built duct and piping drawings the locations of all static and differential pressure sensors (air, water and building pressure).
10. Assist the CxA with implementation and integration of the Monitoring-Based Commissioning (MBCx) hardware (agent) and software to perform MBCx services. This may require the additional points in the BAS system to be made discoverable and implementing BACnet communications protocol, where necessary for interfacing.

Warranty Period

1. Participate in the near-warranty end (ten month) post occupancy visit

H. TAB Contractor

Construction and Acceptance Phases

1. A running log of events and issues shall be kept by the TAB field technicians. Submit hand-written reports of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests to the Owner, CxA and CM/GC at least twice a week.
2. Communicate in writing to the controls contractor all set point and parameter changes made or problems and discrepancies identified during TAB which affect the control system setup and operation.
3. Coordinate with the CxA, acting as the Special Inspector, to complete the required smoke control system special inspections and testing in accordance with the procedures provided in specification Section 014520.
4. Provide a draft TAB report in accordance with specification Section 014520. A copy will be provided to the Owner, design team and CxA.
5. Provide the CxA with any requested data, gathered, but not shown on the draft reports.
6. Provide a final TAB report for the Owner, design team and CxA with details, as in the draft. The final TAB Report shall be submitted with acceptance by the Engineer of Record before beginning TAB Verification.
7. Conduct FPT and checks on the original TAB as specified for TAB requirements in the Cx Plan and Section 019113.

1.4 RELATED WORK

- A. Refer to Section 019113 for a listing of all sections where commissioning requirements are found.
- B. Refer to Section 019113 for systems to be commissioned.
- C. Refer to Section 014520 for smoke control systems testing procedures.

1.5 SUBMITTALS

- A. Division 23 contractor(s) shall provide submittal documentation relative to commissioning to the CxA as requested by the CxA. Refer to Section 019113 for additional Division 23 requirements.

1.6 WEB-BASED COMMISSIONING PORTAL

- A. All general and major contractors participating in the Cx process shall use the web-based Cx Portal, CxAlloy ("Portal" or "CxAlloy") to document the Cx procedures. The Portal is a Web-based Internet hub used to electronically collaborate and coordinate activities and deliverables throughout the Cx process. The Portal is hosted by the CxA and shall be accessible to all Parties participating in the Cx program. The Portal provides a common location to store PFCs, Startup Documentation, FPTs and results, Issues Log tracking, project documents and deliverables. It also serves as a collaborative e-mail hub to facilitate, automate, and track communications between Parties relating to the Cx process.

PART 2 – PRODUCTS

2.1 TEST EQUIPMENT

- A. Division 23 contractor shall provide all test equipment necessary to fulfill the testing requirements of this Division.
- B. Refer to Section 019113 for additional Division 23 test equipment requirements.
- C. Proprietary test equipment required by the manufacturer, whether specified or not, shall be provided by the manufacturer of the equipment through the contractor. The manufacturer shall provide the test equipment, demonstrate its use and assist the CxA in the Cx process.

2.2 INCIDENTAL EQUIPMENT

- A. The Division 23 contractor shall provide all scaffolds, staging, ladders and accessories required to allow testing agencies, consultants and Owner's staff safe access to equipment, valves and other devices located above floor level.

PART 3 – EXECUTION

3.1 MEETINGS

- A. Refer to Section 019113 for additional meeting requirements.
- B. Participation at various commissioning meetings shall depend on the purpose of the meeting and may consist of, but not be limited to, the following members of the project commissioning team: the Owner's representative (i.e. project manager and/or facility staff), the CxA, the CM/GC, subcontractors and/or manufacturer's technical representative as required, the architect/engineer (A/E), and any specialists deemed appropriate by the Cx team.
- C. All the listed Cx team members shall participate in the Cx kick-off meeting.
- D. Participate, as applicable, in Cx coordination meetings in accordance with related Section 019113.
- E. Participate, as needed, in deficiency resolution meetings.

3.2 STARTUP

- A. The HVAC mechanical and controls contractors shall follow the startup, initial checkout procedures, and PFCs listed in the Responsibilities list in this section and Section 019113. The Division 23 contractor has startup responsibility and is required to complete systems and sub-systems, so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility to the CxA or Owner.
- B. FPT is intended to begin upon completion of a system. FPT will not proceed prior to the completion of systems, or sub-systems, which includes completion of the PFCs and completion and approval of any necessary testing, adjusting and balancing (TAB) requirements.

3.3 PRE-FUNCTIONAL CHECKLISTS

- A. Sampling Strategy: 100% of commissioned systems and equipment shall have PFCs completed and submitted for review and approval prior to functional performance testing. The CxA may observe the Division 23 contractor's completion of the PFCs.
- B. Typical aspects of mechanical PFCs verify that the equipment matches the approved submittal, is installed properly, is started-up (and startup is documented) and integrated disciplines (i.e. electrical, equipment vendors, controls) have completed their work required for the equipment and system to function in its entirety. Examples would include spot checking of wiring/termination point-to-points and verification of alarm point parameters and messages.

3.4 CALIBRATION

- A. Sensor and actuator calibration and calibration methods are covered in Section 019113 and Division 23 and are the responsibility of the Division 23 contractor.

3.5 TESTING PREPARATION

- A. Inspect and verify the position of each device and interlock identified on checklists.
- B. Certify that Mechanical systems, subsystems, and equipment have been installed, calibrated, started, quality control tested and code tested (as applicable) and are operating according to the Contract Documents.
- C. Certify that mechanical instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest setpoints have been recorded.
- D. Certify that TAB procedures have been completed and that TAB reports have been submitted, discrepancies corrected, and corrective work approved by the Engineer of Record.
- E. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.6 TAB VERIFICATION

- A. Refer to Section 019113 for a description of the process.
- B. Sampling Strategy: Follow the FPT sampling strategy for TAB verification.
- C. Refer to the TAB contractor responsibilities in Part 1.3 above.

3.7 FUNCTIONAL PERFORMANCE TESTS

- A. FPT is intended to begin upon completion of a system, including startup and completion of the PFCs. Functional testing may proceed prior to the completion of systems or sub-systems at the discretion of the CxA and Owner. Beginning system testing before full completion does not relieve the Contractor from fully completing the system, including all PFCs as soon as possible

- B. Refer to Section 019113 for a list of systems to be commissioned and a description of the process.
- C. Sampling Strategy:
 - 1. Smoke control exhaust fans (100%)
 - 2. AHU smoke control sequencing (100%)
 - 3. Firefighters smoke control panel (100% - coordination with Div 28)
 - 4. Building automation system (associated with the commissioned systems)
- D. Refer to Section 019113, Sampling for the Sampling/Failure Rule.
- E. Typical aspects of mechanical FPTs verify that systems, subsystems and equipment function interactively and throughout the full range of operating conditions (e.g. low load, design load, component failures, alarm conditions, safety interlocks including with life safety systems, etc.) and modes (e.g. normal shutdown, normal auto position, normal manual position, power failure including control power, emergency power, unoccupied, fire alarm, 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. Positive confirmation of state/status shall be shown both locally and via the BAS, as specified in the Contract Documents.
- F. Development of Test Procedures: Before test procedures are written, the CxA shall obtain project contract documentation and a current list of change orders and RFI's affecting equipment or systems, including an updated points list, program code, control sequences and parameters and electrical coordination study. The CxA shall develop specific test procedures and forms for evaluating performance of all integral components and their functioning as a complete unit within design requirements and manufacturer's published data. Prior to execution, the CxA shall provide a copy of the test procedures to the Contractors who shall review the tests for feasibility, safety, equipment and warranty protection.

3.8 TESTING DOCUMENTATION, NON-CONFORMANCE AND APPROVALS

- A. Refer to Section 019113 for specific details on non-conformance issues relating to PFCs and tests.
- B. Refer to Section 019113 for issues relating to functional performance tests.

3.9 OPERATION AND MAINTENANCE (O&M) MANUALS

- A. The following O&M manual requirements do not replace O&M manual documentation requirements elsewhere in these specifications.
- B. Division 23 contractor shall compile and prepare documentation for all equipment and systems covered in Division 23 and deliver to the CM/GC for inclusion in the O&M manuals.
- C. The CxA shall receive a copy of the O&M manuals for concurrent review and comment with the A/E.

3.10 TRAINING OF OWNER PERSONNEL

- A. The CM/GC shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed in accordance with Division 1 requirements. Refer to Section 019113 for additional details.
- B. The CxA shall be responsible for overseeing and approving the content and adequacy of the training of Owner personnel for commissioned equipment. Refer to Section 019113 for additional details.
- C. Mechanical Contractor: The mechanical contractor shall have the following training responsibilities:
 - 1. Provide the CxA with a training plan eight (8) weeks before the planned training according to the outline described in Section 019113.
 - 2. Provide designated Owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of HVAC equipment including, but not limited to, all HVAC equipment (ex. pumps, heat exchangers, chillers, heat rejection equipment, air conditioning units, air handling units, fans, terminal units, controls and water treatment systems, etc.)
 - 3. Training shall normally start with classroom sessions followed by hands-on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure, etc.
 - 4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
 - 5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the startup technician for the piece of equipment, the installing contractor or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.
 - 6. The controls contractor shall attend sessions other than the controls training, as requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.
 - 7. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.
 - 8. Training shall include:
 - a. Use of the printed installation, operation and maintenance instruction material included in the O&M manuals.
 - b. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include startup, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.
 - c. Discussion of relevant health and safety issues and concerns.
 - d. Discussion of warranties and guarantees.
 - e. Common troubleshooting problems and solutions.
 - f. Explanatory information included in the O&M manuals and the location of all plans and manuals in the facility.
 - g. Discussion of any peculiarities of equipment installation or operation.

- h. The format and training agenda in The HVAC Commissioning Process, ASHRAE Guideline 1, is recommended.
 - i. Classroom sessions shall include the use of overhead projections, slides, video/audio-taped material as might be appropriate.
 - 9. Hands-on training shall include startup, operation in all modes possible, including manual, shutdown and any emergency procedures and preventative maintenance for all pieces of equipment.
 - 10. The mechanical contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not controlled by the central control system.
 - 11. Training shall occur after FPT is complete, unless approved otherwise by the Owner.
- D. Controls Contractor: The controls contractor shall have the following training responsibilities:
 - 1. Provide the CxA and AE with a training plan eight (8) weeks before the planned training.
 - 2. The controls contractor shall provide designated Owner personnel training on the control system in this facility. The intent is to clearly and completely instruct the Owner on all the capabilities of the control system.
 - 3. Training manuals. The standard operating manual for the system and any special training manuals will be provided for each trainee, with three extra copies left for the O&M manuals. In addition, copies of the system technical manual will be demonstrated during training and three copies submitted with the O&M manuals. Manuals shall include detailed description of the subject matter for each session. The manuals will cover all control sequences and have a definitions section that fully describes all relevant words used in the manuals and in all software displays. Manuals will be approved by the CxA and A/E.
 - 4. The training will be tailored to the needs and skill-level of the trainees.
 - 5. The trainers will be knowledgeable on the system and its use in buildings. For the on-site sessions, the most qualified trainer(s) will be used. The Owner shall approve the instructor prior to scheduling the training.
 - 6. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
 - 7. The controls contractor shall attend sessions other than the controls training, as requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.
 - 8. There shall be three (3) training sessions:
 - a. Training I. Control System. The first training shall consist of 8 hours of actual training. This training may be held on-site or in the supplier's facility. If held off-site, the training may occur prior to final completion of the system installation. Upon completion, each student, using appropriate documentation, should be able to perform elementary operations and describe general hardware architecture and functionality of the system.
 - b. Training II. Building Systems. The second session shall be held on-site for a period of 8 hours of actual hands-on training after the completion of system commissioning. The session shall include instruction on:
 - 1) Specific hardware configuration of installed systems in this building and specific instruction for operating the installed system, including HVAC systems, lighting controls and any interface with security and communication systems.
 - 2) Security levels, alarms, system startup, shut-down, power outage and restart routines, changing set points and alarms and other typical changed parameters,

overrides, freeze protection, manual operation of equipment, optional control strategies that can be considered, energy savings strategies and set points that if changed will adversely affect energy consumption, energy accounting, procedures for obtaining vendor assistance, etc.

- 3) All trending and monitoring features (values, change of state, totalization, etc.), including setting up, executing, downloading, viewing both tabular and graphically and printing trends. Trainees will actually set-up trends in the presence of the trainer.
- 4) Every screen shall be completely discussed, allowing time for questions.
- 5) Use of keypad or plug-in laptop computer at the zone level.
- 6) Use of remote access to the system via phone lines or networks.
- 7) Setting up and changing an air terminal unit controller.
- 8) Graphics generation
- 9) Point database entry and modifications
- 10) Understanding DDC field panel operating programming (when applicable)

- c. Training III. The third training will be conducted on-site six months after occupancy and consist of 8 hours of training. The session will be structured to address specific topics that trainees need to discuss and to answer questions concerning operation of the system.

- E. TAB Contractor: The TAB contractor shall have the following training responsibilities:

1. TAB shall meet for 4 hours with facility staff after completion of TAB and instruct them on the following:
 - a. Review and discuss the final TAB report, explaining the layout and meanings of each data type.
 - b. Identify and discuss any units, duct runs, diffusers, coils, fans and pumps that are close to or are not meeting their design capacity.
 - c. Discuss any temporary settings and steps to finalize them for any areas that are not finished.
 - d. Other salient information that may be useful for facility operations, relative to TAB.

3.11 DEFERRED TESTING

- A. Refer to Section 019113 for requirements of deferred testing.

3.12 WRITTEN WORK PRODUCTS

- A. Written work products of the Division 23 contractors will consist of the startup and initial checkout plan described in Section 019113 and the completed startup, initial checkout and PFCs.

END OF SECTION 230813

SECTION 230900 – BUILDING AUTOMATION SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Control equipment.
- B. Software.
- C. Graphic Standards
- D. Sequences

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. This Section shall provide the Direct Digital Control (DDC), Energy Management and Building Automation System (BAS) for the air conditioning, heating and ventilating systems, lighting controls and shall interface with other microprocessor-based building subsystems as shown on the drawings and as specified.
- B. This controls specification includes hardware and software designed to control the building system with full graphical representation.
- C. The controls vendor should ensure the building is operating independently of the graphics and has communication back to the GSA server housing the engineering or configuration software. All sequences should be fully functional and verified.
- D. Related Section: Division 23 Section "Sequence of Operation" contains requirements that relate to this Section.
- E. Scope of Work: The existing Building Automation System shall be expanded to include the additional fans and equipment included in this project. Sequences shall be provided as indicated in section "Sequence of Operation".

1.4 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Hydronic Piping: Installation of all wells, control valves, flow switches, temperature sensor sockets, gage taps, flow meters.

- B. Ductwork Accessories: Installation of flow stations, automatic dampers, smoke detectors. Connection of damper end switches Gas Piping: Installation of natural gas flow meters.
- C. Electric Metering: Installation of voltage and current measurement devices in electrical cabinets and the power circuit to the support the measurement device.

1.5 REFERENCES

- A. ASHRAE standard 135-2010.
- B. ASME MC85.1.
- C. NEMA EMC1.

1.6 DEFINITIONS

- A. BACnet: An industry standard data communications protocol for Building Automation Control Networks. Refer to ASHRAE standard 135-2010.
- B. SEC-WAN- Secure Engineered Controls Wide Area Network - Ethernet based network linking remote Wake Co. Facilities with a central location for the purpose of transmitting and receiving building control information. Traffic over this network will be TCP/IP packets.
- C. High Tier- That portion of the Vendor System that connects to the SEC-WAN directly using Ethernet as the physical medium. This is an open, interconnected system that each vendor must be capable of connecting to using standard Ethernet.
- D. Building Level Network (BLN)- That portion of the Vendor System that connects the network controller to the specific monitoring and control devices in the building. Physical medium is serial (RS-485, RS-232) or Ethernet. Traffic over this network shall be BACnet MS/TP or BACnet IP under vendor created subnetwork.
- E. Server- Centrally located, at General Services Center, 401 Capital Blvd., LAN attached, Rack-mounted server computer running Windows Server operating system. High Tier communicate to Server via Ethernet, TCP/IP connection.
- F. TEC or ASC (Device Controller)- Connected to the Network Controller via TCP/IP, MS/TP, or/RS-485/RS-232E. Directly regulates field devices.

1.7 SYSTEM DESCRIPTION

- A. Building Automation System (BAS) Contractor shall provide.
 - 1. A fully integrated building automation system (BAS), UL listed, incorporating direct digital control (DDC) for energy management, equipment monitoring and control, and lighting control capabilities; including interface by ethernet to the existing Wake County Secure Engineered Controls Wide Area Network (SEC-WAN).
 - 2. Complete temperature and lighting control system to be DDC as specified herein.

3. All wiring, conduit, panels, for all DDC temperature controls.
4. All final electrical connections to each stand-alone Application Specific Controller and DDC Controller.
5. BAS Contractor shall be responsible for all electrical work associated with the BAS control system and as called for on the Drawings.
 - a. Perform all wiring in accordance with all local and national codes.
 - b. Install all line voltage wiring, concealed or exposed, in accordance with Division 26.
 - c. Electrical Contractor shall provide 120 volt, 20 amp circuits and circuit breakers from normal and/or emergency power panel for direct digital control systems.
 - d. BAS contractor to provide UPS power for Control Panel where indicated on drawings
 - e. Surge transient protection and power conditioners shall be incorporated in design of system to protect electrical components in all DDC Controllers, Application Specific Controllers and operator's workstations.
 - f. All low voltage electrical control wiring throughout the building shall be installed in accordance with Division 26. Except that digital control wiring and 24V power bus may be run without conduit in accessible ceiling spaces under the provision of NEC, Class 2 when approved.

B. General Product Description:

1. The building automation system (BAS) shall integrate multiple building functions including equipment supervision and control, alarm management, energy management, lighting control and historical data collection. The Building Automation System shall be fully compatible and shall be fully integrated with the existing system presently owned and operated by Wake County.
2. The building automation system shall consist of the following:
 - a. Connection of BAS by Ethernet to dedicated Wake County General Services Administration Building Controls Server. Additional software and programming for BAS Workstation, as specified.
 - b. Stand-alone DDC Controllers compatible with those already installed by Wake County.
 - c. Stand-alone Application Specific Controllers (ASCs.) (ie. Gateway to central building equipment).
3. The system shall be modular in nature and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, DDC Controllers, Application Specific Controllers and operator devices.
4. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution. Each DDC Controller shall operate independently by performing its own specified control, alarm management, operator I/O and data collection. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.
5. DDC Controllers shall be able to access any data from, or send control commands and alarm reports directly to, any other DDC Controller or combination of controllers on the network without dependence upon on network communication outside the controlled building. DDC Controllers shall also be able to send alarm reports to multiple operator workstations without dependence upon a central processing device.

1.8 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections. A minimum of 1 PDF set of documents are required. Building Number verification: The building number should be confirmed with GSA through official written construction communication.
- B. BACnet instance number submittal per the form included in this specification will be completed. BACnet instance numbers are managed by Wake County and are assigned to individual devices. See instance number naming convention for the starting point. Building number and acronym should be confirmed with the County.
- C. BACnet point names should be submitted for all equipment and physical points planned in the project. These point names should adhere to the County naming convention attached. PDF or spreadsheet submission for this specific submittal are acceptable.
- D. Manufacturer's Product Data for each and all types of products specified. Include manufacturer's technical Product Data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials, installation instructions, and startup instructions.
 - 1. Submit manufacturer's product information on all hardware items along with descriptive literature for all software programs to show compliance with specifications.
- E. Shop Drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection. Submit damper leakage and flow characteristics, plus size schedule for controlled dampers.
- F. Shop Drawings, PDF, containing the following information for each control system:
 - 1. Schematic flow diagram showing fans, pumps, coils, dampers, valves, and control devices.
 - 2. Each control device labeled with setting or adjustable range of control.
 - 3. Diagrams for all required electrical wiring. Clearly differentiate between factory-installed and field-installed wiring.
 - 4. Details of control panel faces, including controls, instruments, and labeling.
 - 5. Written description of sequence of operation.
 - 6. Trunk cable schematic showing programmable control unit locations and trunk data conductors.
 - 7. Listing of connected data points, including connected control unit and input device. Itemized list should include each point name per Wake County's point name convention, the control point name and description.
 - 8. Devices with imported points which do not follow the County's point name convention should be converted in a field panel to follow the convention.
 - 9. System configuration showing peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
 - 10. Software description and sequence of operation. This shall include both printed and electronic copies of the program. It shall also include a layman's description of the sequence and a flow chart for a non-programmers interpretation.

11. System configuration diagram showing all panel types and locations as well as communications network and workstations.
 - G. Graphics – Control graphics should be submitted to the county in PDF format. The graphics should be complete with point values populated or simulated to show value font, size, color and unit of measure.
 - H. Wiring diagrams detailing wiring for power, signal, and control systems and differentiating clearly between manufacturer-installed and field-installed wiring.
 - I. Where installation procedures, or any part thereof, are required to be in accord with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the Architect/Engineer prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received.
- 1.9 ADDITIONAL REQUIREMENTS
- A. Correction of Work:
 1. Contractor's Responsibility. The Contractor shall promptly correct all work the Owner finds defective or failing to conform to the Contract Documents. The Contractor shall bear all cost of correcting such work.
 2. During Warranty. If, within the warranty period required by the Contract Documents, any of the work is found to be defective in material or workmanship or not in accordance with the Contract Documents, the Contractor shall correct it promptly after receipt of notice from Owner to do so. Owner shall give notice promptly after discovery of the condition. Contractor shall notify owner within 24 hours of proposed corrections and schedule.
 - B. Coordination of Work During Construction:
 1. The Contractor shall protect the installed works by other trades.
 2. The Contractor shall coordinate with other trades.
 3. The Contractor shall repair any damage caused by his work to building(s) and equipment.
 4. The contractor shall maintain functionality of all existing systems throughout project.
 - C. Warranty and Service:
 1. Standard Warranty.
 - a. The Contractor shall warrant the system to be free from defects in material and workmanship for a period of one (1) years from the date of completion and acceptance of the work by the Owner. Any defects shall be repaired or replaced, including materials and labor at no cost to Wake County.
 2. Wake County reserves the right to make changes to the BAS during the Warranty Period.
 - a. Such changes do not constitute a waiver of warranty. Contractor shall warrant parts and installation work regardless of any such changes made by Wake County, unless the Contractor provides clear and convincing evidence that a specific problem is the result of such changes to the BAS.
 3. Service Response Requirements during the Warranty Period.

- a. Emergency Service: Any malfunction, failure, or defect in any hardware component or failure of any control programming that would result in property damage or loss of comfort control shall be corrected and repaired following telephonic, text, or email notification by the Owner to the Contractor. Emergency service shall be provided 24 hours per day, 7 days per week, and 365 days per year with no exceptions and at no cost to Wake County.
- b. Technician response by telephone, text, or email to any request for service shall be provided within two (2) hours of Wake County's initial request for service.
- c. In the event that the malfunction, failure, or defect is not corrected through the telephonic communication, at least one (1) hardware and software technician, trained in the system to be serviced, shall be dispatched to the Wake County site within four (4) hours of the Wake County initial request for such services, as specified.
- d. Normal Service: Any malfunction, failure, or defect in any hardware component or failure of any control programming that would not result in property damage or loss of comfort control shall be corrected and repaired following telephonic, text, or email notification by the Wake County to the Contractor.
- e. Response by telephone, text, or email to any request for service shall be provided within eight (8) working hours (Contractor specified 40 hours per week normal working period) of the Wake County initial request for service.
- f. In the event that the malfunction, failure, or defect is not corrected through the telephonic communication, at least one (1) hardware and software technician, trained in the system to be serviced, shall be dispatched to the Wake County site within three (3) working days of the Wake County initial request for such services, as specified.
- g. At any time during the Warranty Period that Contractor is on Site for maintenance, emergency, or normal service, Contractor shall notify Wake County and the local building operating personnel. Contractor shall notify said personnel of all work anticipated being involved for the service work. In addition, no work affecting system operation shall commence until express permission is granted. After the work is completed a work order ticket describing in detail all work performed (i.e. hardware replaced or serviced, software or firmware modifications made, etc.), hours worked, follow-up work required, etc., must be signed by an authorized building operator.
- h. Wake County Telephonic Request for Service: Contractor shall specify a maximum of three telephone numbers for Wake County to call in the event of a need for service. At least one of the lines shall be attended at any given time at all times. Alternatively, text messaging can be used for technicians trained in system to be serviced. One of the three notified technicians shall respond to every call within 15 minutes.
- i. Technical Support: Contractor shall provide technical support by telephone throughout the Warranty Period.
- j. Preventive maintenance shall be provided throughout the Warranty Period in accordance with the hardware component manufacturer's requirements.
- k. In the last month of the Warranty Period, all System software and controller firmware, software, drivers, etc. will be upgraded to the latest release (version) in effect at the end of the Warranty Period.

D. Post-warranty Service.

1. Contractor shall ensure accessibility to technical support and replacement parts for ten (10) years past the warranty period.

1.10 PROJECT RECORD DOCUMENTS

- A. Submit under provision of Division 01.
- B. Accurately record actual location of control components, including but not limited to, panels, thermostats, and sensors.
- C. Revise shop drawings to reflect actual installation and operating sequences.
- D. Include data specified in "Submittals" in final "Record Documents" form in hard copy form and in CAD. (DWG or DXF format).
- E. Include a USB drive backup of all BAS control programs in addition to server backup.

1.11 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Division 01.
- B. Maintenance instructions and spare parts list for each type of control device.
- C. Interconnection wiring diagrams with identified and numbered system components and devices.
- D. Final shop drawings should be printed and located in a document sleeve within each control panel.
- E. Keyboard illustrations and step-by-step procedures indexed for each operator function.
- F. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
- G. Calibration records and list of set points.
- H. Submit quotation for annual maintenance service for after the warranty period.

1.12 QUALIFICATIONS & QUALITY ASSURANCE

- A. Materials and equipment shall be the catalogued products of manufacturers regularly engaged in production and installation of automatic temperature control systems and shall be Manufacturer's latest standard design that complies with the specification requirements.
- B. Install system using competent workmen who are fully trained in the installation of temperature control equipment.

- C. Single source responsibility of supplier shall be the complete installation and proper operation of the BAS and control system and shall include debugging and proper calibration of each component in the entire system.
- D. Supplier shall have an in-place support facility within 50 miles of the site with technical staff, spare parts inventory and all necessary test and diagnostic equipment.
- E. All electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Section 15, Governing Radio Frequency Electromagnetic Interference and be so labeled.
- F. BAS shall comply with UL 916 PAZX and 864 UDTZ and be so listed at the time of bid.
- G. Design and build all system components to be fault-tolerant.
 - 1. Satisfactory operation without damage at 110% and 85% of rated voltage and at plus or minus 3 Hertz variation in line frequency.
 - 2. Static, transient and short-circuit protection on all inputs and outputs.
 - 3. Protect communication lines against incorrect wiring, static transients and induced magnetic interference.
 - 4. Network-connected devices to be A.C. coupled or equivalent so that any single device failure will not disrupt or halt network communication.
 - 5. All real time clocks and data file RAM to be battery-backed for a minimum 72 hours and include local and system low battery indication.
 - 6. It must be possible to receive and print out alarms at a central location even when the Server/workstation at that location is nonoperational or taken out of service for periodic maintenance.
- H. Supplier shall be either the authorized regional manufacturer's representative as such with Schneider Electric.

1.13 PRE-INSTALLATION CONFERENCE

- A. Convene a conference two weeks prior to commencing work of this Section, under provisions of Division 01.
- B. Require attendance of parties directly affecting the work of this Section. Controls technicians familiar with the controls wiring and programming are required to attend.

1.14 COORDINATION

- A. The Control System contractor shall schedule and attend a pre-submittal (prior to submission of control diagrams) meeting with Owner for purposes of resolving any potential problems regarding the interface of the proposed system with those existing within General Services and present schedule for approval.
- B. A controls technician familiar with the controls wiring and programming are required to attend both biweekly meetings and commissioning meetings when scheduled.

- C. BACnet instance number submittal sheet must be submitted to GSA to obtain BACnet instance IDs. Equipment should not be connected to the network until configured with the Instance IDs provided.
- D. The control system contractor shall adhere to the Wake County equipment and point naming convention. Controls system contractor shall schedule a nomenclature coordination meeting to occur after notice to proceed, but before contractor begins DDC work. Nomenclature must be approved by GSA. Incorrect point names will be required to be corrected by the completion of the project.
- E. Programming of Control system modifications necessitated by this Project will be done at the General Services' terminal located at 401 Capital Blvd., Raleigh, NC or on-site as necessary. This programming will be complete by the authorized Programmer representing the Control System contractor. Coordination of Owner specified point designations and scheduling of the programming will be the responsibility of the Control System contractor (to be coordinated with Owner). Programming must be done prior to Wake County acceptance of system maintenance responsibility. Any option to perform remote programming or configuration is only allowed at the discretion of the County and is not guaranteed.
- F. System Start-up and Acceptance: Upon completion of the installation, start-up the system and perform all necessary testing. When the system performance is deemed satisfactory in whole or part by Architect/Engineer and by the Wake County Representative, designated by Wake County officials, the system parts will be accepted for beneficial use and placed under warranty. Warranty shall not commence prior to receipt of certificate of completion from Architect/Engineer.
- G. System Testing and Balancing: The Control System contractor shall participate in the Testing and Balancing of the HVAC System and Wake County GSA Representative. The control contractor shall support the Testing and Balancing contractor through the entirety of balancing.

1.15 INPUT/OUTPUT SUMMARY

- A. Refer to end of this Section and drawings.

1.16 DELIVERY, STORAGE, AND HANDLING

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory-mounted on equipment, arrange for shipping of control devices to equipment manufacturer.

1.17 COORDINATION

- A. Control Wiring: The BAS manufacturer shall be responsible for all BAS and temperature control wiring for a complete and operable system. All wire and cable shall be plenum-rated and shall be in accordance with Division 26 specification sections and all local, state and national codes and ordinances.

- B. Where plenum-rated BAS cable is routed in concealed, accessible spaces, the cable may be run in the cable trays or in J-Hooks provided under this section of the specifications. Where plenum-rated BAS cable is routed in exposed or inaccessible areas, it shall be run in conduit provided under this section of the specifications.
- C. Power Wiring:
 - 1. Power wiring indicated (device and circuit designation indicated) on the drawings shall be provided under Division 26.
 - 2. The BAS manufacturer shall be responsible for power wiring not indicated (device or circuit designation not indicated) on the Drawings. It shall be the BAS manufacturer's responsibility to review the Contract Documents to determine the extent of power wiring included in Division 26 and to provide additional power wiring as required. Work shall be in accordance with Division 26 specifications and all local, state and national codes and ordinances.
 - 3. Where the contractor performing work under this section requires an additional circuit for power wiring to a device or panel under paragraph 2 above, an RFI shall be issued requesting approval to use an available circuit in the nearest panel. Once approval is granted, all wiring and conduit from the breaker to the device or panel shall be provided under this section of the specifications.
- D. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation. All conduits shall be concealed within walls and above ceilings unless indicated otherwise.
- E. Coordinate installation of conduit to avoid cutting of finished surfaces.
- F. Coordinate equipment with Division 28 Section "Digital Addressable Fire Alarm" to achieve compatibility with equipment that interfaces with that system.
- G. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.

1.18 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.19 FACILITY SPECIFIC REQUIREMENTS

- 1. In areas accessible to inmates (such as housing or dayrooms) temperature and humidity sensors shall be installed in the return/exhaust air ductwork or rooftop unit return/exhaust and not in a location accessible to inmates.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

1. Ecostruxure, by Schneider Electric.

2.2 NETWORK

- A. All networked control products shall be comprised of an industry standard open protocol internetwork. Communication involving control components (i.e. all types of controllers and operator interfaces) shall conform to ASHRAE 135-2010 BACnet standard. Networks and protocols proprietary to one company or distributed by one company are prohibited.
- B. Access to system data shall not be restricted by the hardware configuration of the building management system. The hardware configuration of the BMS network shall be totally transparent to the user when accessing data or developing control programs.
 1. Software applications, features, and functionality, including administrative configurations, shall not be separated into several network control engines working together.
- C. BAS Server shall be capable of simultaneous direct connection and communication with BACnet/IP corporate level networks without the use of interposing devices.
- D. Any break in Ethernet communication from the PC to the controllers on the Primary Network shall result in a notification at the PC.
- E. Any break in Ethernet communication between the standard client and server workstations on the Primary Network shall result in a notification at each workstation.
- F. The network architecture shall consist of two levels of networks:
 1. The High Tier level network shall be BACnet/IP over Ethernet. It shall network the Building Automation Server, Operator workstations, and Building level controllers. Provide network media converters, routers and switches as necessary for a complete network.
- G. The Floor level network shall be BACnet over the native infrastructure (i.e. if BACnet MS/TP native, all devices should communicate over MS/TP. If BACnet IP native, all devices should communicate over IP to a dedicated BMS router placed inside a BMS enclosure). It shall network to all of the DDC controlled equipment on a floor or in a system and network to a router that connects to the Automaton level BAS backbone. Controllers for the central plant and large infrastructure air handlers shall reside on the backbone BACnet/IP network. The Building Level Controllers shall be able to support subnetwork protocols that may be needed depending on the type of equipment or application. Subnetworks shall be limited to:
 1. BACnet MS/TP.
 2. Modbus.
 3. BACnet IP (On dedicated BMS sub-network).
- H. Use fiber optic cabling for all Ethernet runs longer than 300 ft.

- I. Where a smoke control application is required, provide UL 864 / UUKL listed network switches, and NFPA approved cabling, enclosures and installation methods.
- J. The system shall be installed with a 10% spare capacity on each subnetwork for the addition of future controllers.

2.3 DISTRIBUTED CONTROL REQUIREMENTS

- A. The loss of any one DDC controller shall not affect the operation of other HVAC systems, only for the points connected to the DDC controller.
- B. The system shall be scalable in nature and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, DDC Controllers, and operator devices.
- C. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution. Each DDC Controller shall operate independently by performing its own specified control, alarm management, operator I/O, and data collection. The failure of any single component or network connection shall not interrupt the execution of any control strategy, reporting, alarming and trending function, or any function at any operator interface device.
- D. DDC Controllers shall be able to access any data from, or send control commands and alarm reports directly to, any other DDC Controller on the network without dependence upon a central processing device. DDC Controllers shall also be able to send alarms to multiple operator workstations without dependence upon a central or intermediate processing device.

2.4 SERVER: Existing Server

- A. Owner will provide specifications of the existing server upon request.

2.5 BAS SOFTWARE

- A. Overview.
 - 1. The BAS Contractor shall provide system software capable of engineering level configuration. A thick client GUI shall provide comprehensive user interface and configuration tools to view and edit graphics, controller-level programming, points, schedules, trends, and alarms. Controller programming must be able to be viewed, edited, backed up and reloaded to the controller over the network.
 - 2. The BAS Contractor shall provide system software based on server/thin-client architecture, designed around the open standards of web technology. The BAS server shall communicate using Ethernet and TCP/IP. Server shall be accessed using a web browser over Owner virtual private network.
 - 3. Graphic software shall facilitate user-friendly interface to all aspects of the System Software. The intent of this Specification is to require a graphic package that provides for intuitive operation of the systems without extensive training and experience. It shall facilitate logical and simple system interrogation, modification, configuration, and diagnosis. The Operator Interface shall provide for overall system supervision, graphical

- user interface, management report generation, alarm annunciation, and remote monitoring. The system shall be capable of supporting an unlimited number of clients.
4. The number of network controllers required is dependent on the type and quantity of devices installed. It is the responsibility of the Contractor to determine the quantity and type of devices. The Contractor shall be responsible to properly install the correct number (increase if required) of network controllers from the designed minimum shown on the BAS documents. The Contractor shall confirm the designed network load and architecture with the capabilities of the selected Network Controller. If network communications issues arise as a result of a limited Network Controller resource count the Network Integrator shall furnish, install, and implement additional Network Controllers to reduce the network traffic on each Network Controllers Local Operating Network to less than 50% of maximum bandwidth as recommended by the manufacturer. The total capacity includes all imbedded applications as well as design specific applications.
 5. The web browser GUI shall be HTML5 compatible and provide an interactive user interface and must offer and be configured with the following features as a minimum:
 - a. Trending.
 - b. Scheduling.
 - c. Real time 'live' Graphic Programs.
 - d. Tree Navigation.
 - e. Parameter change of properties.
 - f. Set-point Adjustments.
 - g. Alarm / Event information.
 6. Software Components: All software components of the BAS system software shall be provided and installed as part of this project. BAS software components shall include:
 - a. System Configuration Utilities for future modifications to the system, and controllers shall include all software and programming not specifically itemized in these specifications, which is necessary to implement, maintain, operate, and diagnose the system in compliance with these Specifications.
 - b. Graphical Programming Tools.
 - c. Direct Digital Control Software.
 - d. Application Software.

B. General:

1. All necessary software to form a complete operating system as described in this specification shall be provided.
2. The software programs specified in this Section shall be provided as an integral part of DDC Controllers and shall not be dependent upon any higher level computer for execution.
3. All digital points shall have user defined two-state status indication (descriptors with minimum of 8 characters allowed per state (i.e. summer/winter).
4. All subsystems that can stop or disrupt the program shall be graphically displayed as red/green status.
5. The software shall be provided with an interactive HELP function to assist operators with syntax, abbreviations, commands and saving programs.

C. Control Software Description:

1. The DDC Controllers shall have the ability to perform the following pre-tested control algorithms:
 - a. Two-position control.
 - b. Proportional control.
 - c. Proportional plus integral control.
 - d. Proportional, integral, plus derivative control.
 - e. Automatic tuning of control loops.
2. Control sequence shall include a provision for limiting the number of times each piece of equipment may be cycled within any one-hour period.
3. The system shall provide protection against excessive demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.
4. Upon the resumption of normal power, each DDC Controller shall analyze the status of all controlled equipment, compare it with normal occupancy scheduling and turn equipment on or off as necessary to resume normal operations.

D. Scheduling:

1. Building controllers must store and use operating schedules. BACnet schedules are preferred.
2. Schedules shall reside in the building controller and shall not rely on external processing or network.
3. It shall be possible to define a group of objects as a custom event (i.e., meeting, athletic activity, etc.). Events can then be scheduled to operate all necessary equipment automatically.
4. For points assigned to one common load group, it shall be possible to assign variable time delays between each successive start and/or stop within that group.
5. The operator shall be able to define the following information:
 - a. Time, day.
 - b. Commands such as on, off, auto, etc.
 - c. Time delays between successive commands.
 - d. There shall be provisions for manual overriding of each schedule by an authorized operator.
6. It shall be possible to schedule calendar-based events up to one year in advance based on the following:
 - a. Weekly Schedule. Provide separate schedules for each day of the week. Each of these schedules should include the capability for start, stop, optimal start, optimal stop, and night economizer. When a group of objects are scheduled together as an Event, provide the capability to adjust the start and stop times for each member.
 - b. Exception Schedules. Provide the ability for the operator to designate any day of the year as an exception schedule. Exception schedules may be defined up to a year in advance. Once an exception schedule is executed, it will be discarded and replaced by the standard schedule for that day of the week.
7. Schedule Categories: The system shall allow operators to define and edit scheduling categories (for example, lighting, HVAC occupancy, etc.). Unless otherwise defined in the project documents, separate schedules should be defined for:
 - a. AHU Occupancy.

- b. VAV Occupancy.
 - c. Exterior Lighting Schedule.
 - d. Interior Lighting Schedule.
- E. DDC Controllers shall have the ability to perform all the following energy management routines:
 - 1. Time-of-day scheduling.
 - 2. Calendar-based scheduling.
 - 3. Holiday scheduling.
 - 4. Temporary schedule overrides.
 - 5. Start-Stop Time Optimization.
 - 6. Automatic Daylight Savings Time Switchover.
 - 7. Night setback control.
 - 8. Enthalpy switchover (economizer).
 - 9. Peak demand limiting.
 - 10. Temperature-compensated duty cycling.
 - 11. Fan speed/CFM control (reducing fan speed on CV AHU to save demand charges).
 - 12. Heating/cooling interlock (to prevent system overlap).
 - 13. Hot water reset.
 - 14. Chilled water reset.
 - 15. Equipment sequencing.
 - 16. Supply air reset.
 - 17. Control Loop Algorithm.
 - 18. Adaptive Loop Tuning.
 - 19. Generator load shedding/starting sequence.

NOTE: FOR EXAMPLE, PUMP, AND CHILLER SEQUENCING TO REDUCE PEAK DEMAND. INCLUDE IN SEQUENCE OF OPERATIONS. PROVIDE FOR RAMPING DOWN CHILLERS WHEN ANOTHER CHILLER IS BROUGHT ONLINE TO REDUCE PEAK DEMAND

 - a. All programs shall be executed automatically without the need for operator intervention and shall be flexible enough to allow user customization. Programs shall be applied to building equipment as described in the Sequence of Operations.
- F. DDC Controllers shall be able to execute custom, job-specific processes defined by the user, to automatically perform calculations and special control routines.
 - 1. It shall be possible to use any of the following in a custom process:
 - a. Any system measured point data or status.
 - b. Any calculated data.
 - c. Any results from other processes.
 - d. User-defined constants.
 - e. Arithmetic functions (+, - * /, square root, exp, etc.).
 - f. Boolean logic operators (and/or, exclusive or, etc.).
 - g. On-delay/off-delay/one-shot timers.
 - 2. Custom processes may be triggered based on any combination of the following:
 - a. Time interval.
 - b. Time-of-day.
 - c. Date.

- d. Other processes.
 - e. Time programming.
 - f. Events (e.g., point alarms).
 - 3. A single process shall be able to incorporate measured or calculated data from any and all other DDC Controllers on the network. In addition, a single process shall be able to issue commands to points in any and all other DDC Controllers on the network.
 - 4. Processes shall be able to generate operator messages and advisories to operator I/O devices. A process shall be able to directly send a message to a specified device or cause the execution of a dial-up connection to a remote device such as a printer or pager.
 - 5. The custom control programming feature shall be documented via English language descriptors. The document shall include plain English version of programming for a clear understanding of code and the program. It shall also include a layman's description of the sequence and a flow chart for a non-programmers interpretation.
 - 6. DDC and HVAC Mechanical Equipment Controller shall be capable of comment lines for sequence of operation explanation.
 - 7. Programming shall provide owner with the ability to override reset schedules per point at all user interfaces.
- G. A variety of historical data collection utilities shall be provided to manually or automatically sample, store and display system data for points as specified in the I/O summary.
- 1. DDC Controllers shall store point history data for selected analog and digital inputs and outputs:
 - a. Any point, physical or calculated may be designated for trending. Any point, regardless of physical location in the network, may be collected and stored in each DDC Controllers point group. Two methods of collection shall be allowed: either by a pre-defined time interval or upon a pre-defined change of value. Sample intervals of 1 minute for a 24-hour period shall be provided. Each DDC Controller shall have a dedicated RAM based buffer for trend data and shall be capable of storing a minimum of 25,000 data samples. Provide additional RAM capacity internal or external to the DDC Controller as necessary to meet this requirement.
 - b. If buffer in each DDC Controller in a building over 100,000 square feet cannot store 25,000 data samples, provide additional Controllers in Mechanical Equipment Room to obtain required minimum data storage.
 - 2. Trend data shall be stored at the DDC Controllers and uploaded to the server when retrieval is desired. Uploads shall occur based upon either user-defined interval, manual command or when the trend buffers are full. All trend data shall be available for use in 3rd party personal computer applications.
- H. DDC Controllers shall have the capability to automatically accumulate and store run-time hours for digital input and output points as specified in the point I/O summary.
- 1. The totalization routine shall have a sampling resolution of one minute or less.
 - 2. The user shall have the ability to define a warning limit for runtime totalization. Unique, user-specified messages shall be generated when the limit is reached.
- I. DDC Controllers shall have the capability to automatically sample, calculate and store consumption totals on a daily, weekly or monthly basis for user-selected analog and digital pulse input type points as specified in the point I/O summary.

1. Totalization shall provide calculation and storage of accumulations of up to 99,999.9 units (e.g., KWH, gallons, BTU, tons, etc.).
 2. The totalization routine shall have a sampling resolution of one minute or less.
 3. The user shall have the ability to define a warning limit. Unique, user-specified messages shall be generated when the limit is reached.
- J. DDC Controllers shall have the ability to count events such as the number of times a pump or fan system is cycled on and off. Event totalization shall be performed on a daily, weekly or monthly basis for points as specified in the point I/O summary.
1. The event totalization feature shall be able to store the records associated with a minimum of 9,999.9 events before reset.
 2. The user shall have the ability to define a warning limit. Unique, user-specified messages shall be generated when the limit is reached.
- K. The network shall allow the DDC Controllers to access any data from or send control commands and alarm reports directly to any other DDC and HVAC Mechanical Equipment Controller or combination of controllers on the network without dependence upon a central or intermediate processing device. DDC and HVAC Mechanical Equipment Controllers shall send alarm reports to multiple workstations without dependence upon a central or intermediate processing device. The peer-to-peer network shall also allow any DDC and HVAC Mechanical Equipment Controller to access, edit, modify, add, delete, back up, and restore all system point database and all programs.
- L. System Security: System shall be capable of multi-level access through Login Name and Password. Access to different areas of the BAS system shall be defined in terms of Roles, Privileges and geographic area of responsibility as specified:
1. User access shall be secured using individual security passwords and user names.
 2. Passwords shall restrict the user to the objects, applications, and system functions as assigned by the system manager.
 3. Building Controllers shall be able to assign a minimum of 50 passwords access and control priorities to each point individually. The logon password (at any Operator Interface or portable operator terminal) shall enable the operator to monitor, adjust and control only the points that the operator is authorized for. All other points shall not be displayed at the Operator Interface or portable terminal. Passwords and priorities for every point shall be fully programmable and adjustable.
 4. User Log On/Log Off attempts shall be recorded.
 5. The system shall protect itself from unauthorized use by automatically logging off following the last keystroke. The delay time shall be user-definable.
 6. Use of workstation resident security as the only means of access control is not an acceptable alternative to resident system security in the DDC controller software.
- M. Alarm Management:
1. Alarm management shall be provided within the controller software to monitor and direct alarm information to operator devices.
 2. Each Building Controller shall perform distributed, independent alarm analysis, minimize network traffic and prevent alarms from being lost. At no time shall the Building Controllers ability to report alarms be affected by either operator or activity at a PC workstation, local I/O device or communications with other panels on the network.

3. Conditional alarming shall allow generation of alarms based upon user defined multiple criteria.
 4. An Alarm "shelving" feature shall be provided to disable alarms during testing. (Pull the Plug, etc.).
 5. Binary Alarms. Each binary alarm object shall be set to alarm based on the operator-specified state. Provide the capability to automatically and manually disable alarming.
 6. Analog Alarms. Each analog alarm object shall have both high and low alarm limits. Alarming must be able to be automatically and manually disabled.
 7. All alarm shall include the point's user-defined language description and the time and date of occurrence.
 8. Paged alarm messages shall be routed to user-defined list of phone numbers via SMS messages.
 9. The user shall be able to add a 200-character alarm message to each alarm point to more fully describe the alarm condition or direct operator response. Each Building Controller shall be capable of storing a library of at least 50 alarm. Each message may be assigned to any number of points in the Controller.
 10. Operator-selected alarms shall be capable of initiating a trigger to an advanced annunciation, such as text, email, etc.
 11. An alarm history log shall report the start of the alarm condition, acknowledgement by a user and return of the alarm to normal condition.
- N. Trends: Trends shall both be displayed and user configurable through the Web Browser GUI or thick client. Trends shall be capable on all analog, digital, calculated, and integrated points. A trend log's properties shall be editable using the Navigation Tree and Graphic Pane. Trends must be must user configurable from the thick/thin client including creating new trends on all connected items. Trends that must be set up with a separate configuration tool are NOT acceptable.
1. Viewing Trends: The operator shall have the ability to view trends by using the Navigation Tree and selecting a Trends button in the Graphic Pane located on every page. The system shall allow y- and x-axis maximum ranges to be specified and shall be able to simultaneously graphically display multiple trends per graph.
 2. Local Trends: Trend data shall be collected locally by a Controller located in the building, and periodically uploaded to the BAS server if historical trending is enabled for the object. Trend data, including run time hours and start time date shall be retained in non-volatile module memory. Systems that rely on a gateway/router to run trends are NOT acceptable.
 3. Server/Long Term Trends: Trend data shall be collected periodically by the server and must have demonstrable capability of storing for a minimum of 2 years. Server must provide the ability to easily download at least 2 years' worth of data for multiple points simultaneously to a .csv or Microsoft Excel file with one export.
 4. Events: Events shall be logged for review by the operator, engineering or management personnel. The system shall log each new operator log-on, and whenever an operator changes a set-point or turns any device on or off. Each time the event log records an event, it will record the operator logged in and the type of action taken (set-point change, state change, etc.), along with a date and time stamp.
 5. Resolution. Sample intervals shall be as small as one second. Each trended point will have the ability to be trended at a different trend interval. When multiple points are selected for displays that have different trend intervals, the system will automatically scale the axis.

6. Dynamic Update. Trends shall be able to dynamically update at operator-defined intervals.
7. Zoom/Pan. It shall be possible to zoom-in on a particular section of a trend for more detailed examination and 'pan through' historical data by simply scrolling the mouse.
8. Numeric Value Display. It shall be possible to pick any sample on a trend and have the numerical value displayed.
9. Copy/Paste. The operator must have the ability to pan through a historical trend and copy the data viewed to the clipboard using standard keystrokes (i.e. CTRL+C, CTRL+V).

O. Graphical User Interface.

1. Web Browser Navigation: The Thin Client web browser GUI shall provide a comprehensive user interface. Using a collection of web pages, it shall be constructed to "feel" like a single application and provide a complete and intuitive mouse/menu driven operator interface. It shall be possible to navigate through the system using a web browser to accomplish requirements of this specification. The Web Browser GUI shall (as a minimum) provide for navigation, and for display of animated graphics, schedules, alarms/events, live graphic programs, active graphic setpoint controls, configuration menus for operator access, reports, and reporting actions for events and trends.
2. Login: On launching the web browser and selecting the appropriate domain name or IP address, the operator shall be presented with a login page that will require a login name and password. Navigation in the system shall be dependent on the operator's role privileges.
3. Navigation: Navigation through the GUI shall be accomplished by clicking on appropriate level of a navigation tree (consisting of expandable and collapsible tree control like Microsoft's Explorer program), and/or by selecting dynamic links to other system graphics. Both the navigation tree and action pane shall be displayed simultaneously, enabling the operator to select a specific system or equipment, and view the corresponding graphic.
4. Actions: The web interface shall provide several functional views for each HVAC or mechanical/electrical subsystem specified. A functional view shall be accessed by clicking on the corresponding button:
 - a. Graphics: Using graphical format suitable for display in a web browser, graphics shall include, color building floor-plans, equipment drawings, active graphic setpoint controls, web content and other valid HTML elements. Real-time values displayed on a Web page shall update automatically without requiring a manual "refresh" of the Web page.
 - b. Properties: Shall include graphic controls and text for the following: Locking or overriding objects, demand strategies, and any other valid data required for setup. Changes made to the properties pages shall require the operator to depress an 'accept/cancel' button.
 - c. Schedules: Shall be used to create, modify/edit and view schedules based on the systems geographical hierarchy (using the navigation tree). The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.

- d. Alarms: Shall be used to view alarm information geographically (using the navigation tree), acknowledge alarms, sort alarms by category, actions and verify reporting actions.
- e. Trends: Shall be used to display associated trend and historical data, modify colors, date range, axis and scaling.

2.6 BUILDING CONTROLLER (Existing to remain)

- A. The Building Controller shall be able existing to remain. New controllers shall be integrated into the existing control network.
- B. Each DDC controller shall have a manual override point present on the controller so that the equipment may be operated directly from the controller.
- C. This level of controller shall be used for the following types of systems:
 - 1. Chiller plant systems.
 - 2. Heating plant systems.
 - 3. Cooling Towers.
 - 4. Pumping systems.
 - 5. Air handlers.
 - 6. Systems with over 24 input/output points.
- D. Computing power and memory minimum:
 - 1. A 32-bit, stand-alone, multi-tasking, multi-user, real-time 100MHz digital control microprocessor module.
 - 2. Inputs shall be 16-bit minimum analog-to-digital resolution.
 - 3. Outputs shall be 10-bit minimum digital-to-analog resolution.
 - 4. Memory module (24 Megabyte, minimum) to accommodate all Primary Control Panel software requirements, including but not limited to, its own operating system and databases (see Controllers Software section), including control processes, energy management applications, alarm management applications, historical/trend data for points specified, maintenance support applications, custom processes, operator I/O, dial-up communications.
 - 5. Real time clock and battery.
 - 6. Data collection/ Data Trend module sized for 10,000 data samples.
 - 7. Flash Memory Firmware: Each Building Level Control Panel shall support firmware upgrades without the need to replace hardware.
- E. Onboard or Modular hardware and connections:
 - 1. Primary Network communication module for primary network communications.
 - 2. Secondary Network communication module for secondary network communications.
 - 3. RJ45 port: Minimum 10/100Mbaud.
 - 4. RS485 ports for subnetworks and point expansion.
 - 5. Human Machine Interface port (HMI).
 - 6. USB Port.
- F. Input and Output Points Hardware:

1. Input/output point modules as required including spare capacity.
 2. Monitoring of the status of all hand-off-auto switches.
 3. Monitoring of all industry standard types of analog and digital inputs and outputs, without the addition of equipment to the primary control panel.
 4. Local status indication for each digital input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device. Each primary control panel shall perform diagnostics on all inputs and outputs and a failure of any input or output shall be indicated both locally and at the operator workstation.
 5. Graduated intensity LEDs or analog indication of value for each analog output.
- G. Each DDC Controller shall support:
1. Monitoring of the following types of inputs, without the addition of equipment outside the DDC Controller cabinet:
 - a. Analog inputs.
 - 1) 4-20 mA.
 - 2) 0-10 Vdc.
 - 3) Thermistors.
 - 4) 1000 ohm RTDs.
 - b. Digital inputs.
 - 1) Dry contact closure.
 - 2) Pulse Accumulator.
 - 3) Voltage Sensing.
 2. Direct control of electronic actuators and control devices. Each DDC Controller shall be capable of providing the following control outputs without the addition of equipment outside the DDC Controller cabinet:
 - a. Digital outputs (contact closure).
 - 1) Contact closure (motor starters, sizes 1-4).
 - b. Analog outputs.
 - 1) 4-20 mA.
 - 2) 0-10 Vdc.
- H. Each DDC Controller / network router shall have a minimum of 10% spare capacity for future point connection. The type of spares shall be in the same proportion as the implemented I/O functions of the panel, but in no case shall there be less than two spares of each implemented I/O type. Provide all processors, power supplies and communication controllers complete so that the implementation of a point only requires the addition of the appropriate point input/output termination module and wiring.
1. Provide sufficient internal memory for the specified control sequences and have at least 25% of the memory available for future use.
- I. Each DDC Controller shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all panel components. The DDC Controller shall provide both local and remote annunciation of any detected component failures, low battery conditions or repeated failure to establish communication.

- J. In the event of the loss of normal power, there shall be an orderly shutdown of all DDC Controllers to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 60 days. Controls Contractor shall provide external battery back-up, if necessary to meet this requirement.
 - 1. Upon restoration of normal power, the DDC Controller shall automatically resume full operation without manual intervention.
- K. Building Level Controllers shall have the capability to serve as a gateway between Modbus subnetworks and BACnet objects. Provide software, drives and programming.
- L. Isolation shall be provided at all primary control panel terminations, as well as all field point terminations to suppress induced voltage transients consistent with IEEE Standards 587-1980.
- M. Code compliance:
 - 1. Approvals and standards: UL916; CE; FCC.
 - 2. Provide UL864-UUKL where called for in the sequences of operations.
- N. Accessories:
 - 1. Appropriate NEMA rated metal enclosure.
 - 2. Power supplies as required for all associated modules, sensors, actuators, etc.
- O. The operator shall have the ability to manually override automatic or centrally executed commands at the primary control panels via local, point discrete, on-board hand/off/auto operator override switches. If on board switches are not available, provide separate control panels with HOA switches. Mount panel adjacent to primary control panel. Provide hand/off/auto switch for each digital output, including spares.
- P. Environment.
 - 1. Controller hardware shall be suitable for the anticipated ambient conditions.
 - 2. Controllers used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures and shall be rated for operation at 0°C to 49°C (32°F to 120°F).
 - 3. Controllers used in conditioned space shall be mounted in dust-proof enclosures and shall be rated for operation at 0°C to 49°C (32°F to 120°F).
- Q. Immunity to power and noise.
 - 1. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage.
 - 2. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).
 - 3. Isolation shall be provided at all primary network terminations, as well as all field point terminations to suppress induced voltage transients consistent with:
 - a. RF-Conducted Immunity (RFCI) per ENV 50141 (IEC 1000-4-6) at 3V.
 - b. Electro Static Discharge (ESD) Immunity per EN 61000-4-2 (IEC 1000-4-2) at 8 kV air discharge, 4 kV contact.

- c. Electrical Fast Transient (EFT) per EN 61000-4-4 (IEC 1000-4-4) at 500V signal, 1 kV power.
 - d. Output Circuit Transients per UL 864 (2,400V, 10A, 1.2 Joule max).
- 4. Isolation shall be provided at all Building Controller's AC input terminals to suppress induced voltage transients consistent with:
 - a. IEEE Standard 587 1980.
 - b. UL 864 Supply Line Transients.
 - c. Voltage Sags, Surge, and Dropout per EN 61000-4-11 (EN 1000-4-11).
- R. Provide a separate DDC Controller for each HVAC system as indicated on the drawings and in the input/output summary, Section 1.15. It is intended that each unique system be provided with its own point resident DDC Controller.

2.7 APPLICATION SPECIFIC CONTROLLERS (ASC)

- A. Each Application Level Control Panel shall operate as a stand-alone controller capable of performing its user selectable control routines independently of any other controller in the system. Each application specific controller shall be a microprocessor-based, multi-tasking, real-time digital control processor.
- B. Each DDC Controller shall be able to extend its performance and capacity through the use of remote application specific controllers (ASCs).
- C. The Application Controller Software shall be capable of BACnet communications. The BACnet Advanced Application Controller (B-AAC) shall have demonstrated compliance to BTL through BTL listing and shall substantially conform to BACnet Advanced Application Controller (B-AAC) device profile as specified in ANSI/ASHRAE 135-2004 or ANSI/ASHRAE 135-2008. Each ASC shall operate as a stand-alone controller capable of performing its specified control responsibilities independently of other controllers in the network.
- D. Communication:
 - 1. BAS Network: The Advanced Application Controller shall support the following Data Link Layers.
 - a. BACnet MS/TP Master or slave.
 - b. Modbus.
 - c. BACnet IP (On dedicated BMS sub-network).
- E. Provide an Application Specific Control Panel for each of the following types of equipment (if applicable):
 - 1. Constant Air Volume (CAV) boxes.
 - 2. Duct mounted reheat coils.
 - 3. Fan coil Units.
 - 4. Reheat Coils.
 - 5. Supplemental AC units.
 - 6. Variable Air Volume (VAV) Boxes.
 - 7. Other terminal equipment.

F. Terminal Equipment Controllers (VAV Controllers):

1. Provide for control of each piece of equipment, including, but not limited to, the following:
2. Controllers shall include all point inputs and outputs necessary to perform the specified control sequences. As a minimum, 50% of the point outputs (except for unit ventilator controllers) shall be of the Universal type; that is, the outputs may be utilized either as modulating or two-state, allowing for additional system flexibility. In lieu of Universal outputs, provide a minimum of 50% spare outputs of each type via additional point termination boards or controllers. Analog outputs to field devices shall be either 4 to 20 ma or 1 to 10 volt. Tri-state signals (floating control) shall not be acceptable. Terminal equipment controllers utilizing proprietary control signals and actuators shall not be acceptable. As an alternative, provide DDC Controllers or other ASCs with industry standard outputs for control of all terminal equipment.
3. Each controller performing space temperature control shall be provided with a matching room temperature sensor. The sensor may be either RTD or thermistor type providing the following minimum performance requirements are met:
 - a. Accuracy: $\pm 1^{\circ}\text{F}$
 - b. Operating Range: 0° to 115°F
 - c. Set Point Adjustment Range: 55° to 95°F
 - d. Set Point Modes
 - 1) Independent Heating, Cooling,
 - 2) Night Setback Heating, Night Setback Cooling
 - e. Calibration Adjustments: None required.
 - f. Installation: Up to 150 ft. from Controller.
 - g. Each room temperature sensor shall include a terminal jack integral to the sensor assembly. The terminal jack shall be used to connect a portable operator's terminal to control and monitor all hardware and software points associated with the controller. In lieu of an internal jack, provide a method for local communications to controller without the need for outside network or provide a separate terminal jack mounted on a stainless steel wall plate adjacent to the sensor to facilitate direct access to the controller via the terminal.
 - h. Each room sensor shall also include the following auxiliary devices:
 - 1) Setpoint Adjustment Dial.
 - 2) Temperature Indicator.
 - 3) Override Switch.
 - i. The setpoint adjustment dial shall allow for modification of the temperature by the occupant. Setpoint adjustment may be locked out, overridden or limited as to time or temperature through software by an authorized operator at the central workstation, DDC Controller, or via the portable operator's terminal. In lieu of an integral adjustment dial, provide a separate dial mounted on a stainless steel wall plate adjacent to the sensor to perform the specified functionality.
 - j. The temperature indicator shall be a digital readout and have the ability to indicate at minimum current temperature and temperature setpoint.
 - k. An override switch shall initiate override of the night setback mode to normal (day) operation when activated by the occupant. The override function may be locked out, overridden or limited as to the time through software by an authorized operator at the central workstation, DDC Controller or via the portable operator's

terminal. In lieu of an integral switch, provide a separate momentary contact switch mounted on a stainless steel wall plate adjacent to the sensor to perform the specified functionality.

4. Each controller shall perform its primary control function independent of other DDC Controller LAN communication, or if LAN communication is interrupted. Reversion to a fail-safe mode of operation during LAN interruption is not acceptable. The controller shall receive its real-time data from the DDC Controller time clock to ensure LAN continuity. Each controller shall include algorithms incorporating proportional, integral and derivative (PID) gains for all applications. All PID gains and biases shall be field-adjustable by the user via terminals as specified herein. This functionality shall allow for tighter control of space conditions and shall facilitate optimal occupant comfort and energy savings. Controllers that incorporate proportional and integral (PI) control algorithms only shall not be acceptable.
5. Provide each terminal equipment controller with sufficient memory to accommodate point databases, operating programs, local alarming and local trending. All databases and programs shall be stored in non-volatile EEPROM, EPROM and PROM, or minimum of 72-hour battery backup shall be provided. The controllers shall be able to return to full normal operation without user intervention after a power failure of unlimited duration. Provide uninterruptible power supplies (UPSs) of sufficient capacities for all terminal controllers that do not meet this protection requirement. Operating programs shall be field-selectable for specific applications. In addition, specific applications may be modified to meet the user's exact control strategy requirements, allowing for additional system flexibility. Controllers that require factory changes of all applications are not acceptable.
6. Programming and/or configurations should be editable over the network from the standard thin or thick client software.
7. Variable Air Volume (VAV) Box Controllers: shall support the following types of pressure independent terminal boxes as a minimum:
 - a. VAV cooling only.
 - b. Fan-powered VAV with hot water reheat.
8. All VAV box control applications shall be field-selectable such that a single controller may be used in conjunction with any of the above types of terminal units to perform the specified sequences of control. This requirement must be met in order to allow for future design and application changes and to facilitate system expansions. Controllers that require factory application changes are not acceptable.
9. The VAV box controllers shall be powered from a 24 VAC source and shall function normally under an operating range of 18 to 28 VAC (-25% to +17%), allowing for power source fluctuations and voltage drops. The BAS contractor shall provide a dedicated power source and separate isolation transformer for each controller. The controllers shall also function normally under ambient conditions of 32° to 122°F and 10% to 95%RH (non-condensing). Provide each controller with a suitable cover or enclosure to protect the intelligence board assembly.
10. The controller shall include a differential pressure transducer that shall connect to the terminal unit manufacturer's standard averaging air velocity sensor to measure the average differential pressure in the duct. The controller shall convert this value to actual airflow. Single point air velocity sensing is not acceptable. The differential pressure transducer shall have a measurement range of 0 to 4000 fpm and measurement accuracy of 5% at 400 to 4000 fpm, ensuring primary air flow conditions shall be controlled and

maintained to within 5% of setpoint at the specified parameters. The BAS contractor shall provide the velocity sensor if required to meet the specified functionality.

11. Each controller shall include provisions for manual and automatic calibration of the differential pressure transducer in order to maintain stable control and insuring against drift over time. Calibration shall be accomplished by stroking the terminal unit damper actuator to a 0% position so that a 0 cfm air volume reading is sensed. The controller shall automatically accomplish this whenever the system mode switches from occupied to unoccupied or vice versa. Manual calibration may be accomplished by either commanding the actuator to 0% via the POT or by depressing the room sensor override switch. Calibration of the transducer at the controller location shall not be necessary.
12. Damper actuator should provide indication of damper position. Active proportional feedback or calculated position shall be available. Specific damper position shall be controllable. If calculated position is used, this controller must self-calibrate on a daily basis and be set up for off-hours calibration. Floating point damper actuators which do not allow position control are not acceptable.
13. The VAV box controller shall interface to a matching room temperature sensor as previously specified. The controller shall function to maintain space temperature to within 1.5°F of setpoint at the room sensor location.
14. Each controller performing space heating control shall incorporate an algorithm allowing for modulation of a hot water reheat valve as required to satisfy space heating requirements. Each controller shall also incorporate an algorithm that allows for resetting of the associated air handling unit discharge temperature if required to satisfy space cooling requirements. This algorithm shall function to signal the respective DDC Controller to perform the required discharge temperature reset in order to maintain space temperature cooling setpoint.
15. Each controller shall have a discharge air temperature sensor on the VAV box for system operator to use for diagnostics.

2.8 BUILDING SYSTEMS INTEGRATION

- A. The BAS System shall establish a seamless interconnection with other building, electrical and/or mechanical subsystems that employ BACnet protocol (Chillers, Variable frequency drives, etc.). These systems shall be controlled, monitored and graphically programmed with the same Graphical Programming Language (GPL) used for all other control modules.

B. VARIABLE FREQUENCY DRIVE INTEGRATION

1. VFDs should be controlled via hardwired operation including Enable, speed, alarm points.
2. Unless specifically noted on the drawings, the motor/fan/pump status should be monitored separately through a current transducer.
3. VFDs shall have modbus/BACnet capabilities - the drives should be integrated into the control system and points should be available on the controls system.
4. At a minimum the following BACnet points shall be integrated: Actual drive speed (hz), Motor Current (A-avg), Motor Voltage (V-rms), Driver Power (kW), Drive Energy (kWh) Alarms. Drive Power should be converted to kW if not available as BACnet point.

C. LIGHTING CONTROL SYSTEM INTEGRATION

1. Where lighting controllers are to be integrated through a dry-contact, the relay should have hand/on/auto switch for local override
2. Where lighting controllers are to be integrated through modbus/BACnet – the lighting control panel should be integrated into the control system and points should be available on the controls system.

2.9 CONTROL PANELS

- A. Controllers in mechanical rooms shall be mounted in a minimum of NEMA 1 enclosures. Exterior controllers shall be mounted in a NEMA 4X Stainless Steel enclosure.
- B. Mount on walls at an approved location or provide a free standing rack built of unistrut or hot dipped galvanized of sufficient strength to maintain rigidity.
- C. Panels shall be constructed of 16 gauge, furniture-quality steel, or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock and with ANSI 61 gray polyester-powder painted finish, UL listed. Provide common keying for all panels.
- D. Provide power supplies for control voltage power.
- E. Dedicate 1 power supply to the DDC controller. Other devices shall be on a separate power supply, unless the power for the control device is derived from the controller terminations.
- F. Power supplies for controllers shall be a transformer with a fuse or circuit breaker. Power supplies for other devices can be plain transformers.
- G. All power supplies for 24V low voltage wiring shall be class 2 rated and less than 100VA. If low voltage devices require more amps, then provide multiple power supplies. If a single device requires more amps, then provide a dedicated power supply in a separate enclosure and run a separate, non-class 2 conduit to the device.
- H. Surge transient protection shall be incorporated in design of system to protect electrical components in all DDC Controllers and operator's workstations.
- I. All devices in a panel shall be permanently mounted, including network switches, modems, media converters, etc.
- J. Provide a pocket to hold documentation.
- K. Wire management should be completed using covered, slotted wireway (Panduit) in the control panels. Panels should be sized to accommodate wireways and DIN rail mounted equipment as necessary. Wires should not be left hanging.

2.10 INPUT/OUTPUT SENSORS

- A. Temperature:
 1. Unless otherwise stated in this specification temperature sensors to be platinum RTD type.

2. Resistance tolerance at calibration point to be no more than 0.2% Calibration point 0 degrees F.
3. Use insertion elements in ducts not affected by temperature stratification or smaller than one square meter. Use averaging elements where larger or prone to stratification, sensor length 18" to 25 ft as required.
4. Insertion elements for liquids shall be brass or stainless steel with minimum insertion length of 2-1/2 inches.
5. Room temperature sensors used with terminal equipment controllers to be either thermistor or RTD type with set-point adjustment, temperature indicator, terminal jack and over-ride switch. Refer to Terminal Equipment Controller Specification for detailed requirements.
6. Provide outside air sensors with watertight inlet fitting, shielded from direct rays of sun.

B. Humidity Sensor:

1. Duct type shall include a dew point probe with an adjustable/removable draft shield and a transmitter mounted to the sensor probe case.
2. Outside Air type shall include a probe in a weather-proof housing and a transmitter for indoor mounting.
3. Dew Point monitoring range -40 to +115 degrees F, dewpoint.
4. Room Sensors: Range of 0-99 percent RH.
5. Elements: Accurate within 5 percent over 20-95% RH range with linear output.
6. Output signal 0-10V or 4-20MA DC.
7. Accuracy at Calibration Point.
 - a. Dewpoint Element +-1.1 degrees F, dewpoint.
 - b. Dewpoint Sensor +- 1.5 degrees F, dewpoint.
8. Voltage, probe heater - 120 Vac.
9. Voltage, transmitter - 26 Vdc.

C. Static Pressure Sensors:

1. Unidirectional with ranges not exceeding 150 percent of maximum expected input.
2. Temperature compensated with typical thermal error of .015 percent of full scale per degree F. in temperature range of 35 to 135 degrees F.
3. Accuracy: One percent of full scale with repeatability 0.3 percent.
4. Output: 0-10 Vdc or 4-20ma with power at 13 to 36 vdc.

D. Equipment Operation Sensors:

1. Status Inputs for Fans: Current sensitive relay with current transformers, adjustable and set to 175 percent of rated motor current.
2. Status Inputs for Pumps: Differential pressure switch piped across pump with adjustable pressure differential range of 8 to 60 psi and on the pump side from any check valve or triple duty valve.
3. Status Inputs where differential pressure sensing is impractical: Current sensitive relay with current transformers, adjustable and set to 175 percent of rated motor current.

2.11 CONTROL VALVES

- A. Control Valves: Factory fabricated, of type, body material, and pressure class indicated. Where type or body material is not indicated, make selection as determined by manufacturer. For installation requirements and pressure class, based on maximum pressure and temperature rating of piping system.
- B. Globe Pattern: As follows:
 - 1. Terminal Unit Control Valves: Bronze body, bronze trim, 2 or 3 port as indicated, replaceable plugs and seats, union and threaded ends.
 - a. Rating: Service at 125 psi WSP (862 kPa) and 250 deg F (121 deg C).
 - b. Sizing: 3-psi (21-kPa) maximum pressure drop at design flow rate, to close against pump shutoff head.
 - c. Flow Characteristics: 2-way valves have equal percentage characteristics; 3-way valves have linear characteristics.
 - d. Actuator : Proportional, modulating, self-contained – see VALVE AND DAMPER ACTUATORS

2.12 DAMPERS

- A. Dampers: AMCA-rated, opposed blade design; form frames from not less than 0.1084-inch (2.8-mm) galvanized steel with mounting holes for duct mounting; damper blades not less than 0.0635-inch (1.6-mm) galvanized steel, with maximum blade width of 8 inches (203 mm).
 - 1. Blades secured to 1/2-inch (13-mm) diameter, zinc-plated axles keyed, hexagonal square or other shape solid shaft that has positive (no slip) engagement with the provided actuator. Provided with zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass. Ends sealed against spring-stainless-steel blade bearings. Thrust bearings at each end of every blade.
 - 2. Operating Temperature Range: From -40 to 200 deg F (-40 to 93 deg C).
 - 3. For standard applications as indicated, (as selected by manufacturer's sizing techniques) with optional closed-cell neoprene edging.
 - 4. For low-leakage applications as indicated, provide parallel or opposed blade design (as selected by manufacturer's sizing techniques) with inflatable seal blade edging, or replaceable rubber seals, rated for leakage at less than 10 cfm/sq. ft. (51 L/s/sq. m) of damper area, at differential pressure of 4 inches wg (995 Pa) when damper is being held by torque of 50 inch-pounds (5.6 N x m); test in accordance with AMCA 500.
 - 5. Dampers shall be provided with mechanical end switches independent of the actuator position sensor to indicate a positive open or closed position of the damper blade itself.
 - 6. Parallel dampers only allowed for non-modulating (on/off) operation.
 - 7. Damper/Actuator combination shall be capable of modulating at maximum static pressure rating.

2.13 VALVE AND DAMPER ACTUATORS

- A. Basis of design: Belimo.
- B. Electronic Direct-Coupled. Electronic direct-coupled actuation shall be provided.

- C. Actuator Mounting. The actuator shall be direct-coupled over the shaft, enabling it to be mounted directly to the damper shaft. Where a shaft extension is required a manufactured option accessory shall be used. Field fabricated extensions and couplers will not be allowed. The actuator shall employ a V-bolt and toothed V-clamp fastening technique. Single point bolt or screw type fastener for circular valve and damper shafts is unacceptable.
- D. Electronic Overload Sensing. The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the entire rotation of the actuator. Mechanical end switches or magnetic clutch to deactivate the actuator at the end of rotation are not acceptable.
- E. Power Failure/Safety Applications. For power failure/safety applications, an internal mechanical spring return mechanism shall be built into the actuator housing. Non- mechanical forms of fail-safeoperation are not acceptable.
- F. Spring Return Actuators. All spring return actuators shall be capable of both clockwise and counterclockwise spring return operation by simply changing the mounting orientation.
- G. Proportional Actuators. Proportional actuators shall accept a 0 to 10VDC or 0 to 20mA control input and provide a 2 to 10VDC or 4 to 20mA operating range. An actuator capable of accepting a pulse width modulating control signal and providing full proportional operation of the damper is not acceptable.
- H. 24 Volts (AC/DC) actuators. All 24VAC/DC actuators shall operate on Class 2 wiring and shall not require more than 20VA for AC or more than 8 watts for DC applications. Actuators operating on 120VAC power shall not require more than 20VA. Actuators operating on 230VAC shall not be acceptable.
- I. Non-Spring Return Actuators. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators shall have a manual crank for this purpose.
- J. Modulating Actuators. All modulating actuators shall have an external, built-in switch to allow reversing direction of rotation.
- K. Conduit Fitting. Actuators shall be provided with a conduit fitting.
- L. U.L. Listing. Actuators shall be Underwriters Laboratories Standard 873 listed.
- M. Warranty. Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque and shall have a minimum 5-year manufacturer's warranty.
- N. Actuators shall be selected utilizing no more than 80% of the cataloged torque rating.
- O. Actuators shall be electronic, low voltage (24 VAC/VDC), NEMA 2 rated for all applications. Two- position may utilize 120 VAC actuators. Actuators shall have UL, CSA and ISO 9001 certification and approvals. Actuators shall have a minimum operating range of -22 to 122 F. Optional auxiliary switches shall be available if required by the sequence. Actuators shall be fully modulating/proportional, floating/tri-state, or two- position as required. Pulse width modulation is unacceptable. Actuators shall have visual position indicators. Proportional

actuators shall be field programmable to operate in sequence with other devices without additional transducers. All actuators except two- position shall be capable of providing a constant rotation rate independent of the load. Actuators used on dampers or valves shall be designed to directly couple to a stem, shaft or ISO style-mounting pad. Damper actuators or damper actuators adapted for use with control valves shall utilize V-bolt toothed V-clamp shaft fastening technique. Single point, bolt, or single screw type shaft fastening techniques for circular or round damper or valve shafts is unacceptable.

- P. Ganged actuators must allow for single point manual operation.

2.14 UTILITY METERING

- A. Electrical Metering: Electrical demand shall be from installed electrical meter including all circuits indicated on the drawings. Meter to be supplied by controls contractor, installed by the electrical contractor, and configured by the controls contractor.
1. Model: Dent Powerscout PS48 HD or Siemens MD-48HD with RoCoil CT's properly sized to fit application or engineer approved equal.
 2. The BAS shall record the following and have the ability to report it at daily, monthly and yearly intervals:
 - a. Instantaneous kW demand with time and date (trended 15 min intervals).
 - b. kWh with time and date totalized for:
 - 1) Day to Date.
 - 2) Previous Day.
 - 3) Month to Date.
 - 4) Previous Month.
 - 5) Year to Date.
 - 6) Previous Year.
- B. Natural Gas Metering: Gas usage in cubic feet per hour shall be from pulsing dry contacts provided by the Utility Company at the gas meter or by a dedicated meter as specified on the drawings. Meter to be supplied by controls contractor, installed by the mechanical contractor, and configured by the controls contractor.
1. Model: Onicon, Model F-5400 or engineer approved equal.
 2. Inline Meter with Built-in Flow Conditioner
 3. Where a dedicated meter is installed both flow and total volume should be interfaced from the meter. Totalization should be performed by the meter and not through calculations.
 4. The BAS shall record the following and have the ability to report:
 - a. Cubic Feet used with time and date totalized for:
 - 1) Day to Date.
 - 2) Previous Day.
 - 3) Month to Date.
 - 4) Previous Month.
 - 5) Year to Date.
 - 6) Previous Year.
 - b. Instantaneous, CFH demand with time and date (trended 15 min intervals).

- C. Domestic Water Metering: Water usage in gallons per hour shall be monitored from pulsing dry contacts provided by installation of a contractor provided water meter. The DDC system shall be capable of measuring and scaling any pulse rate provided by the water meter. Provide meter with all installation hardware necessary to enable insertion and removal of meter without system shutdown. The flow meter shall be hand insertable up to 400 psi. Turbine rotation shall be detected by electronic impedance base sensing (non-magnetic).
 - 1. Model: The water meter shall be equal to Dwyer Model WNT Multi-Jet NSF Certified or engineer approved equal with scaled output (1 gallon per pulse) Meter to be supplied by controls contractor with any necessary plumbing accessories and installed by Plumbing contractor.
 - 2. Both flow and total volume should be interfaced from the meter. Totalization should be performed by the meter and not through calculations.
 - 3. The BAS shall record the following and have the ability to report it at daily, monthly and yearly intervals:
 - a. Gallons used with time and date totalized for:
 - 1) Day to Date.
 - 2) Previous Day.
 - 3) Month to Date.
 - 4) Previous Month.
 - 5) Year to Date.
 - 6) Previous Year.
 - b. Instantaneous, gpm demand with time and date (trended 15 min intervals).

2.15 MISCELLANEOUS CONTROLS

- A. The control manufacturer shall furnish all two-position relays, current transformers, NEMA rated enclosures, thermostats and all other controls necessary to meet the specifications and provide for a properly operating automatic control system. All control devices connected in line-voltage circuits shall be U.L. listed and of a type to meet the current and voltage requirements of the particular application.
- B. If a device or piece of equipment is provided with the ability to communicate directly with the controls system through any form of communication protocol (such as BACnet or Lon) and the device is indicated to be connected to the BAS the controls contractor shall integrate their controls to that device.
- C. All low voltage communication and network wiring shall have orange jackets.

2.16 SMOKE DETECTORS

- A. Smoke detectors shall be furnished under Division 28 and installed under this Section.
- B. Wiring from smoke detectors to fire alarm system shall be under Division 28.
- C. Wiring from smoke detectors to mechanical equipment shall be under this Section.

2.17 MISCELLANEOUS RELAYS AND SWITCHES:

- A. General: Where required by the sequence of operation switches, relays, and miscellaneous devices necessary to accomplish the sequence shall be provided under this Section.

2.18 FIREFIGHTER'S SMOKE CONTROL PANEL

- A. Coordinate with Division 28.

Smoke Control Panel shall be control units listed for all appropriate functions in the UL Fire Protection Equipment Directory under classification UUKL. Wall-mounted panel with a graphic display of the building plans, with switches and LED indicators. Refer to details on Drawings. The control panel shall be mounted in a surface mounted enclosure, with concealed conduits. The control panel shall be constructed with a 0.125-inch aluminum substrate and a 7 mil polyester film overlay. The polyester film overlay shall be protected by a non-glare textured coating that is non-yellowing, durable, and scratch resistant. LEDs, resistors, diodes, etc., shall be mounted on printed circuit boards (PCBs). All wiring to the PCBs shall be made on solder type terminal turrets. All switches shall be mounted from the rear of the panel.

1. Graphic Colors: The film overlay shall be a graphic as shown in the drawings with black lines and legends, and colored background areas and text. The graphic is to be made of 7-mil photographic film, having all accent colors applied to the backside of the film. Important areas such as stairwells and smoke control panel locations shall be highlighted for easy identification. The panel supplier shall furnish a color chart with a minimum of 22 accent colors.
2. Graphic Surface: The working surface (polyester film) shall be bonded to the aluminum substrate with an adhesive that has been proven not to delaminate in similar applications. The adhesive shall achieve 100% bonding without any creases, bumps, or blemishes in the working surface (face) of the graphic. The working surface of the graphic shall be textured and non-glare. Translucent areas shall be made in the overlay for back lighted indicators. LEDs shall not protrude through the polyester film overlay. Backlit areas shall be subdued until the LED is illuminated. The illumination of any indicator shall be clearly visible, from any viewing angle in front of the working surface of the graphic.
3. Substrate: The aluminum substrate shall have holes for LEDs and switches. The substrate shall have holes drilled and tapped for mounting the printed circuit boards. The aluminum substrate shall have a clear finish to prevent oxidation.
4. Indicators: The indicators shall be high intensity LEDs, T-1 ¾ in size, and rated for a normal operation at a current of 20mA. The LEDs shall have an operating life of a minimum of 170,000 hours of continuous or pulsed operation. The body and lens of the LEDs shall be constructed of high impact plastic. The LEDs shall be mounted on .062" printed circuit boards constructed of epoxy glass material, NEMA Type FR-4, Grade 10 resistors and diodes for current limiting and LED test shall also be mounted on the printed circuit boards. Solder type, pressed in turrets shall be provided for electrical connections to the LEDs. All field wiring shall terminate on modular screw clamp type terminals located in the rear of the enclosure.
5. Switches: Three position switches shall be furnished for ON-OFF-AUTO operation of each system zone or sub-zone where indicated on the drawing. Switches shall be rated for the load served. A momentary push button shall be provided for simultaneous testing of all LEDs. All switch wiring shall be terminated on modular screw clamp type terminal strips mounted in the rear of the enclosure.

6. Enclosure: The enclosure shall be made from cold rolled steel and be assembled using all welded and formed steel construction. The enclosure shall be primed and painted with a baked enamel and have a textured finish. A security door with a viewing window shall be supplied to prevent unauthorized operation of the control panel switches.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that conditioned power supply is available to control units and operator workstation. Verify that field end devices and wiring are installed before proceeding with installation.

3.2 INSTALLATION

- A. Install equipment as indicated to comply with manufacturer's written instructions.
- B. Install software in control units and operator workstation. Implement all features of programs to specified requirements and appropriate to sequence of operation.
- C. The DDC control panel shall be mounted in the same mechanical room as the equipment being controlled, or an adjacent utility room. Exact locations shall be coordinated in the field with the owner and engineer.
- D. Where Ethernet is used for building level communication, a dedicated switch should be located in a BMS enclosure with the other DDC control panels and be configured on a private sub-network separate from the Wake County network.
- E. Multiple systems can be programmed on the same controller as long as they are in the same room. Systems on separate floors shall have separate controllers.
- F. VAV boxes subnetworks shall be connected to the AHU controller that feeds those boxes. If multiple subnetworks are needed, then the VAV shall be grouped into subnetworks in an orderly method, such as per floor, per wing, etc.
- G. Remote sensors shall be wired to the control panel of the equipment it is controlling, not across the network.
- H. Signals to remote motor control centers shall be hard wired to the control panel, not across the network.
- I. Terminal units shall each have their own controller. Only exceptions are:
 1. Groups of reheat coils.
 2. Groups of exhaust fans.
- J. Connect and configure equipment and software to achieve the sequence of operation specified.

- K. Verify location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation. Locate 60 inches (1524 mm) above floor.
- L. Any required ethernet cable not already identified in the scope of the project shall be the responsibility of the vendor to coordinate and install.
- M. Install damper actuators on outside of duct in warm areas, not where exposed to outdoor temperatures.
- N. Install labels and nameplates to identify control components.
- O. Install white vinyl label on each sensor/actuator indicating installation date of sensors/actuators (vinyl handheld label maker).
- P. Install labels to VAV and terminal boxes on ceiling grid below device. Provide ceiling grid labels to identify sensors and devices above ceiling outside of mechanical rooms. (white vinyl handheld label maker).
- Q. Wires shall be labeled at every final and intermediate termination. Labels should identify point, panel and equipment number.
- R. Actuators with line voltage shall be fed from a circuit dedicated to actuators only for a single piece of equipment.
- S. Install electrical work in accordance with Division 26. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.
- T. Conduits for control wiring shall not exceed 40% fill.
- U. Graphics should be completed and active prior to the commissioning process and prior to substantial completion.
- V. Point Structuring and Naming:
 - 1. The intent of this Section is to require a consistent means of naming points across Wake County WAN. Configure the systems from the perspective of Wake County WAN, not solely the local Project. The following requirement establishes a standard for naming points and addressing Buildings, Networks, Devices, Instances, and the like. The convention is tailored towards Wake County WAN and as such, the interface shall always use this naming convention. BACnet systems shall also use this naming convention. For non- BACnet systems, the naming convention shall be implemented as much as practical, and any deviations from this naming convention shall be approved by Wake County.
 - 2. Each Network Controller shall have English language descriptors for all system points, variables, parameters etc. located and accessible from the NC memory. All point naming shall match between all system files and record documents.
 - 3. Point Summary Table: The term 'Point' is a generic description for the class of object represented by analog and binary inputs, outputs, and values. With each schematic, Network Integrator shall provide a Point Summary Table listing:
 - a. Equipment type.
 - b. Equipment number.

- c. Equipment code.
 - d. Full point name (see Point Naming Convention paragraph).
 - e. Point description.
 - f. Object type.
 - g. Engineering units.
 - h. Network variable.
- 4. Additional fields for non- BACnet systems shall be appended to each row. Point Summary Table shall be provided in in electronic format (ODBC-compliant).
 - 5. Point Summary Table shall also illustrate Network Variable Data Links.
 - 6. The System Integrator shall coordinate with Wake County representative to compile and submit a proposed Point Summary Table for review (see point naming submittal) prior to any object programming or Project startup. Wake County shall grant approval of final point names to be verified through Commissioning by issuing the approved alarms to the System Integrator.
 - 7. All points shall be identified per Wake County's point naming convention.
 - 8. System Enable Points – Each AHU, hot water system, chilled water system should indicate a system enable point to allow for taking the unit offline manually.
 - 9. Adjustable points – Temperature associated with a temperature reset, pressure reset, outdoor air lock out or other variable indicated as adjustable should be created as a point and be indicated on a graphic for adjustment.
 - 10. All functional variables with in the code such as mode, Temperature Bands, Average Temperature, Cooling Loop Outputs and other points used within the programming should be created as virtual points for the purposes of troubleshooting.
 - 11. Actuators should be programmed and displayed as 0% = closed and 100% = open.
 - 12. Comment lines should be included in the code which is active on the controller. Comments should be complete enough to determine what is included within the code without reading the programming language.
- W. Trend Point Naming. The naming convention for points shall be in plain English and separate the data using the underscore (_) and include the building number, building acronym, equipment, point and time interval or COV. Trend Name Examples:
- 232FVL_AHU01_SupplyAirTemp_15min
 - 232FVL_Vav01_15_SpaceTemp
 - 232_FVL_ChilledWater_ChillerEnable_COV
 - 232FVL_HotWater_Boiler02_FireRate_15min
- 1. Trends shall be as follows: Unless otherwise noted on the construction drawings, 15 minute interval trends should be set up for:
 - a. All points, physical and virtual associated with AHUs
 - b. All points, physical and virtual associated with DX Systems
 - c. VAV, terminal - space temperature, humidity, temperature setpoint, valve position, discharge temp, air flow and damper position
 - d. Chiller/Boiler Plants – Chiller/Boiler enable, supply temp, return temp, secondary supply temp, secondary return temp, primary and secondary pump – enable, status, speed, and all flow readings
 - e. Chiller BACnet values – enable, supply temperature, temp set point, capacity, power, compressor status
 - f. Boiler BACnet values – enable, supply temperature, temperature set point, firing rate

- g. Water Submeters – Total volume, year to date volume, flow rate
 - h. Natural Gas Submeter – Total Volume, year to date Volume, flow rate
 - i. Electrical Submeter – Circuit total power (kW), Circuit energy (kwh) total, Circuit energy (kWh) year to date
- X. Alarm Setup: Unless otherwise noted on the construction drawings, alarm should be set up via hard wired points or other software-type alarms for a minimum of:
 - 1. Fire Alarm Active Alarm
 - 2. Chiller Alarm
 - 3. Boiler Alarm
 - 4. VFD Alarm
 - 5. Dirty Filter Alarm
 - 6. High Limit Alarm
 - 7. Low Temp Alarm (Freezestat)
 - 8. Pump/Fan Status Alarm
 - a. Unless otherwise noted on the construction drawings, alarms should be page for a minimum of the following:
 - 1) Chiller Alarm
 - 2) Boiler Alarm
 - 3) VFD Alarm
 - 4) Fire Alarm

3.3 MANUFACTURER'S FIELD SERVICES

- A. Prepare and start systems under provisions of Division 01.
- B. Start-up and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.
- C. Provide service engineer to instruct Owner's representatives in operation of systems plant and equipment, for one 8 hour period.

3.4 SCHEDULING OF TRAINING SHALL BE COORDINATED WITH OWNER

- A. Provide basic operator training for a minimum of 4 persons on sequence of operations data display, alarm and status descriptions, requesting data, execution of commands and request of logs. Include a minimum of (12) hour's dedicated instructor time. Provide as-built documents and O & M manuals for each person. A portion of the instruction time shall be specifically dedicated to the building life safety systems. As built drawings on paper and cad. As built drawings shall have a link to them shown on the controls front-end.
- B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three (3) visits to Project during other than normal occupancy hours for this purpose.

3.5 COMMISSIONING

- A. Manufacturer's Field Services: Provide the services of a factory-authorized service representative to start control systems. Shall be scheduled with owner. Test and adjust controls and safeties.
- B. System Equipment: Upon completion of installation of each piece of equipment, field- inspect and mechanically and electrically test equipment for proper function.
- C. Field Materials: Upon completion of installation of each piece of equipment, field-inspect and mechanically and electrically test equipment for proper function.
- D. Acceptance Testing. Upon completion of the installation, the Contractor shall start up the system and perform all necessary trending, scheduling calibration, testing, and debugging operations. The Contractor in the presence of the Owners' representative shall perform an acceptance test. Acceptance test procedure to be submitted, for approval no later than 4 weeks prior to testing. Submission of test procedure shall imply that systems are complete, functional and that contractor has verified performance. Successful completion of acceptance testing shall be required prior to substantial completion.
- E. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
 - 2. Test and adjust controls and safeties.
 - 3. Test calibration of controllers inputs, outputs, and sensors.
 - 4. Test each point through its full operating range to verify that safety and operating control set points are as required.
 - 5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
 - 6. Test each system for compliance with sequence of operation.
 - 7. Test software and hardware interlocks.
- F. DDC Verification:
 - 1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
 - 2. Check instruments for proper location and accessibility.
 - 3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
 - 4. Check instrument tubing for proper fittings, slope, material, and support.
 - 5. Check installation of air supply for each instrument.
 - 6. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
 - 7. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
 - 8. Check temperature instruments and material and length of sensing elements.
 - 9. Check control valves. Verify that they are in correct direction.
 - 10. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
 - 11. Check DDC system as follows:

- a. Verify that DDC controller power supply is from emergency power supply, if applicable.
 - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
 - c. Verify that spare I/O capacity has been provided.
 - d. Verify that DDC controllers are protected from power supply surges.
12. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.
13. Calibrating and Adjusting:
- a. Calibrate instruments.
 - b. Make three-point calibration test for both linearity and accuracy for each analog instrument.
 - c. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
 - d. Control System Inputs and Outputs:
 - 1) Check analog inputs at 0, 50, and 100 percent of span.
 - 2) Check analog outputs using milliamper meter at 0, 50, and 100 percent output.
 - 3) Check digital inputs using jumper wire.
 - 4) Check digital outputs using ohmmeter to test for contact making or breaking.
 - 5) Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.
 - e. Flow:
 - 1) Calibrate the input sensors to the specified accuracy.
 - 2) Manually operate flow switches to verify that they make or break contact.
 - f. Pressure:
 - 1) Calibrate pressure transmitters at 0, 50, and 100 percent of span.
 - 2) Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.
 - g. Temperature:
 - 1) Calibrate the input sensors to the specified accuracy.
 - 2) Calibrate temperature switches to make or break contacts.
 - h. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
 - 1) Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
 - 2) Provide diagnostic and test instruments for calibration and adjustment of system.
 - 3) Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before

initiating startup procedures. Document all tests and provide to Wake County.

- i. Adjust initial temperature and humidity set points.
 - j. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three (3) visits to Project during other than normal occupancy hours for this purpose.
 - k. Carbon Dioxide: Verify CO2 readings with a calibration kit or against a known accurate device.
- G. Replace damaged or malfunctioning controls and equipment.
- H. Start, test, and adjust control systems.
- I. Demonstrate compliance with requirements.
- J. Adjust, calibrate, and fine tune circuits and equipment to achieve the sequence of operation specified without fault or failure.

3.6 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by authorities having jurisdiction.
- 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. Visual Inspection: Conduct visual inspection prior to testing.
 - 2. Smoke control inspection and testing shall be performed per the NC Building Code (2018 Ed.) Section 909.18.8.
 - 3. Test smoke control system for operation per the Contractor-submitted control sequence, and per the requirements of NCBC 909.18, including but not limited to "Special Inspections."
 - 4. Testing shall include but not be limited to the following
 - a. Initiate one or more smoke detectors in the space using an approved method such as a smoke canaster.
 - b. Monitor the dampers, and units associate with the smoke zone and provide a written log that each device operated per the Fire Matrix and sequences on the contract documents and that each device returned to its normal state after the test.
 - c. Test each control switch and AHU switch on the smoke control panel in each position. and provide a written log that each device operated correctly, and that each device returned to its normal state after the test. Place all switches back in automatic position after the test.

3.7 DEMONSTRATION

- A. Demonstrate a complete and fully operational system to Owner as required by contract documents near completion of project.

3.8 GRAPHICS

- A. See Graphic standards.
- B. Contractor shall submit graphics via a submittal and correct any deficiencies prior to project acceptance
- C. Contractor shall allow four (4) hours of additional graphic design/modify time to adjust, develop, modify, and install the graphics after the DDC controls are installed and operational. The owner will provide marked up graphics illustrating the work.

3.9 SMOKE CONTROL

- A. Smoke Control System Sequence: In accordance with NCBC 909-17, the smoke control system shall activate components in an appropriate sequence. Fans, dampers, damper position switches, differential air pressure switches and other components of the Smoke Control Systems are furnished and installed by Division 23. Each step in the sequence has a time duration, which shall be listed in the Contractor's sequence submittal with incremental and total time required for operation. Refer to "Sequences of Operations for HVAC Controls" for additional requirements. In principle, minimum sequence steps include but are not limited to:
 - 1. Smoke Detector detects smoke. Fire Alarm (FA) system resets detector and waits for automatic alarm verification before initiating alarm and smoke control sequence. Up to 15 seconds duration.
 - 2. FA System sends signal to BAS for smoke zone that has detected smoke. BAS shall go into automatic smoke control mode for that zone and, where applicable, shut down HVAC systems. Up to 20 seconds duration.
 - 3. BAS system receives confirmation from damper position switches that dampers are in correct position. Up to 10 seconds duration.
 - 4. BAS system sends signal to activate smoke control fans. Up to 5 seconds duration.
 - 5. BAS system receives confirmation from monitor module at smoke fan motor differential pressure switch relays that associated fan(s) are operational. Up to 10 seconds duration.
 - 6. Total sequence duration: $15 + 20 + 10 + 5 + 10 = 60$ seconds delay from detection of smoke until full system operation.
 - a. If a flow switch causes smoke control system activation, the 15-second smoke verification delay for smoke detector activation (item 1 above) shall not occur (allow 5 seconds for flow switch) bringing the total to 50 seconds.
- B. Smoke Control System Testing
 - 1. The building automation system shall be programmed to initiate a weekly test of the smoke control system per IMC513.12.1. The test shall include positive confirmation of actuation, testing, and the presence of power downstream of all disconnects. A preprogrammed weekly test sequence shall report abnormal conditions audibly, visually

- and by printed report. The preprogrammed weekly test shall operate all devices, equipment and components used for smoke control except initiation devices.
2. Consult the owner for day and time for this test to occur.

PART 4 - GRAPHICS AND POINT NAMING

4.1 COORDINATION

- A. Graphics should be developed and submitted to the County via a project submittal.
- B. Graphics should be completed and active prior to the commissioning process.

4.2 GRAPHIC GUIDELINES

- A. Standard units of measure should be used and labeled as follows:

Value	Unit	Value	Unit
Temperature	°F	Enthalpy	BTU/lb°F
Water Flow	Gpm	Carbon Dioxide	Ppm
Air Flow	CFM	Static Pressure	"WC
Relative Humidity	%RH	Filter Differential Pressure	"WC
Water Differential Pressure	psi	Power	kW
Gas Volume	CCF	Electrical Energy	kWh
Gas Flow	CFH		

- B. Setpoints – should be located beneath each point controlled to a set point. Points in override shall have a visual indication they have been overridden.
- C. System Enable Points – Each AHU, hot water system, chilled water system should indicate a system enable point to allow for taking the unit offline manually.
- D. Adjustable points – Temperature associated with a temperature reset, pressure reset, outdoor air lock out or other variable indicated as adjustable should be created as a point and be indicated on a graphic for adjustment.
- E. Actuators/Damper/Valves should be programmed and displayed as 0% = closed and 100% = open.
- F. Control and monitoring points of equipment should be located beneath the item being controlled.

4.3 GRAPHIC EXAMPLES

- A. To the extent technically possible all graphics shall be based upon the examples shown below. All features of the graphics, such as title block, navigation buttons, etc., shall always be located in the same general area on each Graphic.
- B. Navigation – Buildings should be organized in a navigation tree and include the three-digit building identification number.



Figure 1: Navigation Tree, Example 1

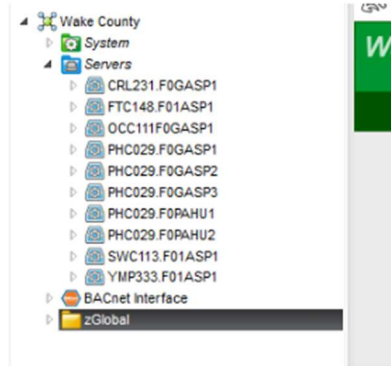


Figure 2: Navigation Tree, Example 2

- C. Navigation – A top navigation bar should include site-specific graphics for the main mechanical and control systems, and the outdoor conditions for that site.



Figure 3: Navigation Bar, Example 1

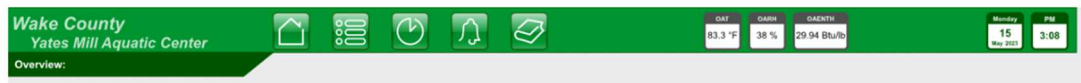


Figure 4: Navigation Bar, Example 2

- D. Building Home Page – A building-specific home page should be created to provide an overview of the main systems status. The home page should include the navigation bar, building photo, and readings for the main systems such as AHU supply temperatures, hot water and chiller water supply temperatures and average building temperature.

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Figure 5: Building Home Page, Example 1

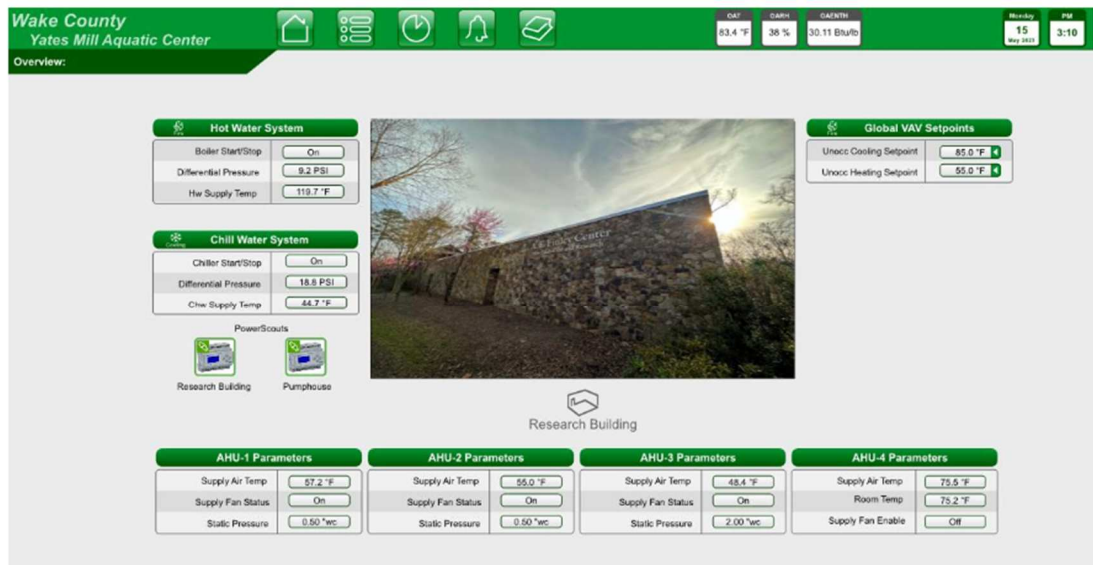


Figure 6: Building Home Page, Example 2

- E. AHU Graphics – Air handling unit graphics should represent the ductwork and airflow as accurately as possible. Where multiple ducts or paths are present, the graphics should represent this. Sensor locations should be accurately represented.
1. Content, top right –
 - a. “AHU Parameters” shall be located in a box and include major control points such as AHU Enable, Occupancy Modes, Dehumidification Enable, Economizer Enable points shall be displayed.
 - b. Dehumidification Enable, Economizer Enable points shall be displayed
 - c. “AHU Setpoints” under the parameters, if an air handler has space setpoints, there shall be displayed in a box and include room temperature, occupied cooling/heating setpoints, unoccupied cooling/heating setpoints.

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Figure 7: AHU Graphic, Example 1

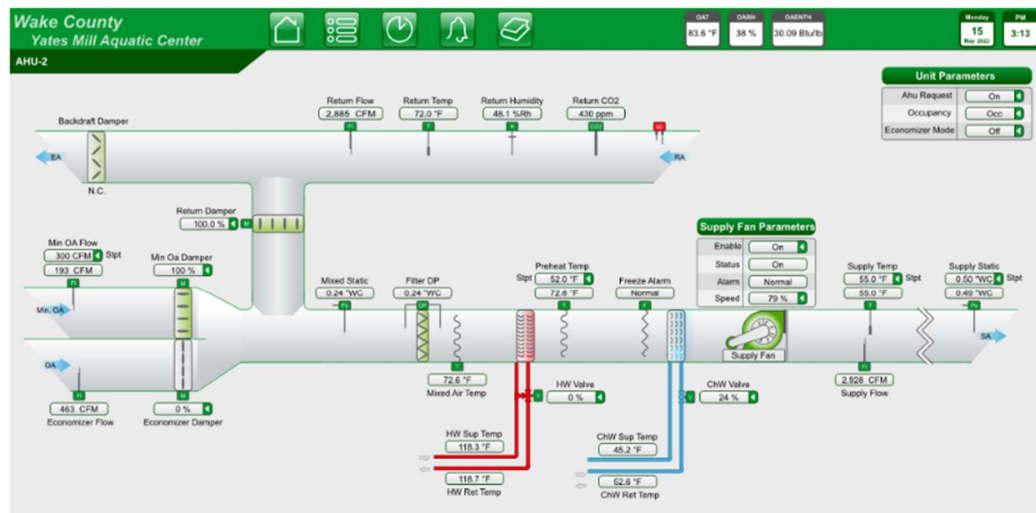


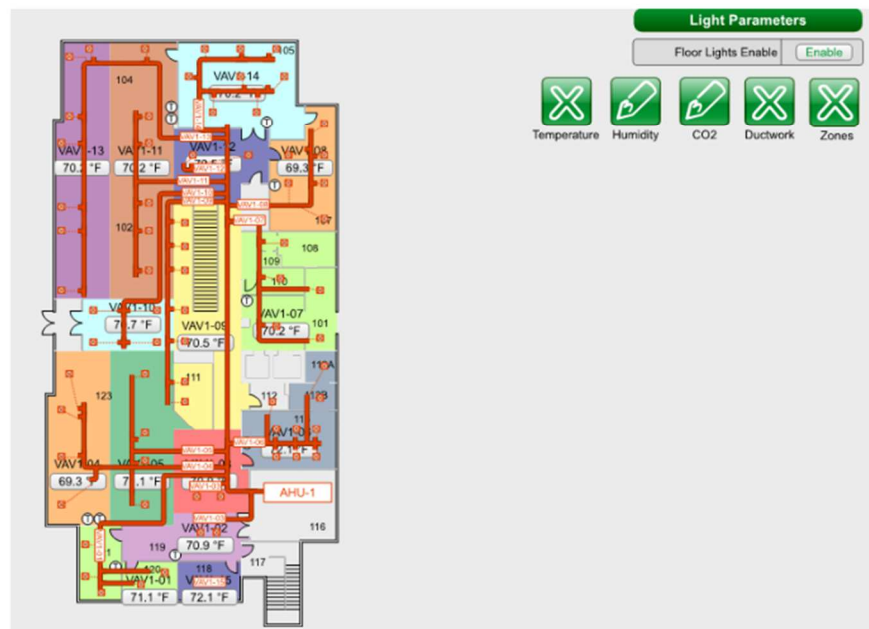
Figure 8: AHU Graphic, Example 2

- F. Floor Navigation – A floor plan should be created from the architectural floor plans and include inside walls, doorways and room numbers. Duct work shall include colored main duct as well as diffusers - one color per AHU. A legend should indicate AHU number and color. VAV boxes should be indicated and the zone ductwork and zone should be identifiable. Main equipment should be indicated and labeled. Ductwork should be a layer that can be toggled on/off. Floor color per zone that can be toggled on/off is preferred, but optional.

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Figure 9: Floor Navigation - Example 1



4 Figure 10: Floor Navigation - Example 2

- G. VAV Table – A table of all VAV associated with an air handler should be placed on a graphic. Table should be separated per AHU.

VAV Tec	Room Served	Space Temp	Ctl Stp	Sstp Dial	Room Min Sstp	Room Max Sstp	Fan	Airflow	Max CFM	Min CFM	Dmpr Pos	AUX Temp	Heat Cool
TEC 01	Womens RR 112	71.8 °F	71.0 °F	YES	68.0 °F	76.0 °F	ON	152.0 ft3/min	596.0 ft3/min	120.0 ft3/min	100.0 %	71.0 °F	COOL
TEC 02	AS. Manager 118	69.75 DEG F	71.0 °F	YES	68.0 °F	76.0 °F	ON	144.0 ft3/min	744.0 ft3/min	148.0 ft3/min	13.6 %	71.0 °F	HEAT
TEC 03	Lockers 120	71.00 DEG F	71.0 °F	YES	68.0 °F	76.0 °F	ON	108.0 ft3/min	540.0 ft3/min	108.0 ft3/min	11.2 %	74.5 °F	HEAT
TEC 04	Periodicals Room	72.5 °F	74.0 °F	YES	68.0 °F	76.0 °F	ON	316.0 ft3/min	1,600.0 ft3/min	320.0 ft3/min	28.8 %	75.0 °F	HEAT
TEC 05	Workroom 110	70.8 °F	71.0 °F	YES	68.0 °F	76.0 °F	ON	544.0 ft3/min	992.0 ft3/min	200.0 ft3/min	63.6 %	71.0 °F	COOL
TEC 06	Program Rm 108	70.3 °F	20.0 %	YES	68.0 °F	76.0 °F	ON	740.0 ft3/min	2,132.0 ft3/min	428.0 ft3/min	0.0 %	71.5 °F	COOL

5 Figure 11: VAV Table - Example 1

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Unit Name	Area Served	Occupancy	Space Temp	Base Clg Stpt	Base Htg Stpt	Effective Stpt	Supply Temp	Flow	Flow Stpt	Damper Pos	Terminal Load	Reheat Pos	Space RH%
F01VAV1-01	Offices 120&121	Occupied	71.1 °F	72.0 °F	68.0 °F	72.0 °F	61.2 °F	286 CFM	240 CFM	98 %	0 %	0 %	---
F01VAV1-02	1-01 stat/Self Check 119	Occupied	70.9 °F	72.0 °F	68.0 °F	72.0 °F	61.5 °F	94 CFM	90 CFM	27 %	0 %	0 %	---
F01VAV1-03	1-06 stat/Computer/Printing	Occupied	70.9 °F	72.0 °F	68.0 °F	72.0 °F	60.7 °F	139 CFM	150 CFM	25 %	0 %	0 %	---
F01VAV1-04	1-06 stat/Perimeter 122&123	Occupied	69.3 °F	72.0 °F	68.0 °F	72.0 °F	60.6 °F	280 CFM	270 CFM	25 %	0 %	0 %	---
F01VAV1-05	1-06 stat/Interior 122&123	Occupied	71.1 °F	72.0 °F	68.0 °F	72.0 °F	62.6 °F	162 CFM	195 CFM	18 %	0 %	0 %	---
F01VAV1-06	Interior 122&123	Occupied	72.1 °F	72.0 °F	68.0 °F	72.0 °F	60.5 °F	194 CFM	216 CFM	24 %	0 %	0 %	---
F01VAV1-07	1-08 stat/Workroom 113	Occupied	70.2 °F	72.0 °F	68.0 °F	68.0 °F	60.5 °F	898 CFM	900 CFM	60 %	100 %	0 %	---
F01VAV1-08	Central East	Occupied	69.3 °F	72.0 °F	68.0 °F	68.0 °F	72.7 °F	542 CFM	540 CFM	41 %	0 %	2 %	---
F01VAV1-09	1-10 stat/Workroom 107	Occupied	70.5 °F	72.0 °F	68.0 °F	72.0 °F	62.3 °F	271 CFM	315 CFM	14 %	0 %	0 %	---
F01VAV1-10	Core/Circulation	Occupied	70.7 °F	72.0 °F	68.0 °F	72.0 °F	60.9 °F	302 CFM	300 CFM	29 %	0 %	0 %	---
F01VAV1-11	1-14 stat/Interior 102&104	Occupied	70.2 °F	72.0 °F	68.0 °F	72.0 °F	61.0 °F	266 CFM	270 CFM	26 %	0 %	0 %	---
F01VAV1-12	1-14 stat/Youth Svr 103	Occupied	70.5 °F	72.0 °F	68.0 °F	72.0 °F	61.0 °F	127 CFM	135 CFM	25 %	0 %	0 %	---
F01VAV1-13	1-14 stat/Perimeter 102.104	Occupied	70.2 °F	72.0 °F	63.0 °F	72.0 °F	60.8 °F	519 CFM	540 CFM	31 %	0 %	0 %	---
F01VAV1-14	Child Program 105	Occupied	70.2 °F	72.0 °F	68.0 °F	72.0 °F	70.3 °F	349 CFM	200 CFM	0 %	0 %	0 %	---
F01VAV1-15	Telecom 1st Floor	Occupied	72.1 °F	72.0 °F	68.0 °F	72.0 °F	60.8 °F	89 CFM	90 CFM	36 %	0 %	0 %	---

Figure 12: VAV Table - Example 2

- H. VAV Graphic – An individual VAV graphic should include all relevant status and setpoints.

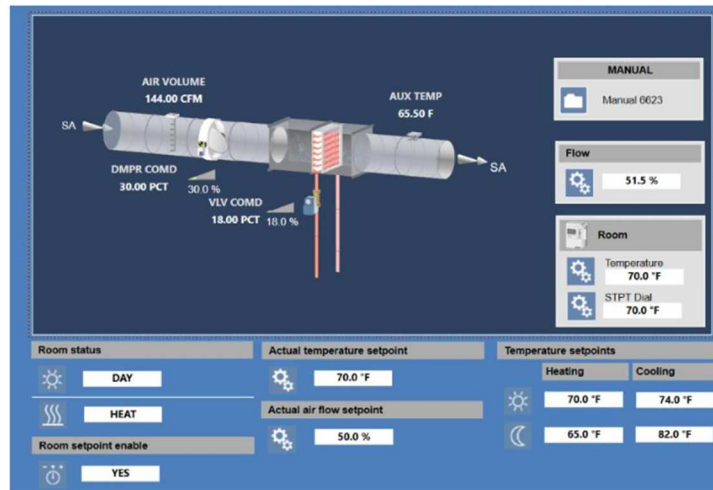


Figure 13: VAV Graphic

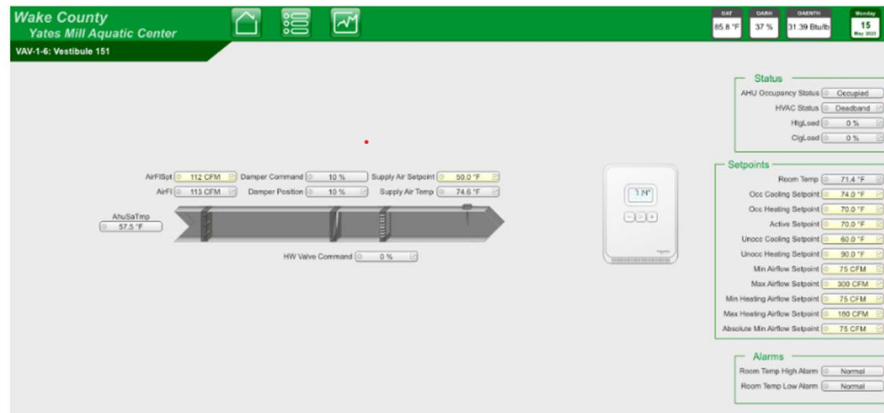


Figure 14: VAV Graphic, Example 2

- I. VFD Graphics – A separate graphic should be created for each VFD in addition to the information presented as part of the AHU or system. The separate graphic should show BACnet values to the extent possible.

- J. VFD Graphic within in other pages: The VFD on the equipment (AHU/Hot Water Plant/etc) page should show enable, status, alarm, command speed and power.



6 *Figure 15: VFD points in Equipment Graphic*

- K. Chiller and Boilers plants

1. Content, top right
 - a. System Enable point, lockout temps, VAV call, AHU call, Dehum call should be located in a "System" box.
 - b. Beside each Chiller/Boiler: Chiller/Boiler Enable, Status, Temp Setpoint and alarm should be located in a box. BACnet points for the chiller/boiler should be included such as firing rate, current capacity/compressor status.
 - c. Temperature resets based on outside air should be indicated in a table.
 - d. Flow diagram may not fit on a single Graphic for large or complex Central Plants. If this happens, the condenser water system and the chilled water system shall be broken out into separate Graphics.



Figure 16: Chiller Plant Graphic, Example 1



Figure 17: Boiler Plant Graphic, Example 1

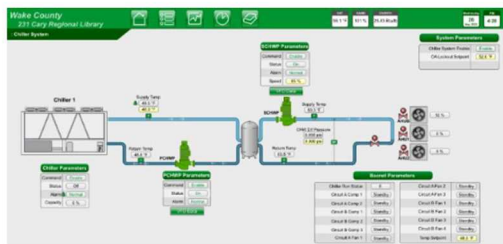


Figure 18: Chiller Plant Graphic, Example 2

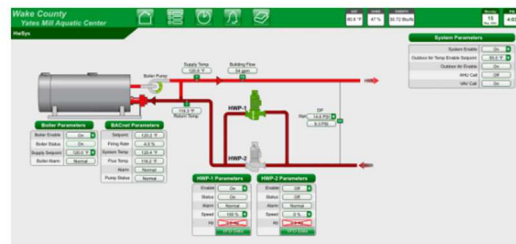


Figure 19: Boiler Plant Graphic, Example 2

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- L. Temperature Reset: Temperature resets which are dependent on two other variables should be included on the graphic in a table format.

DAmp	SupTmP	
20	180	°F
70	100	

Figure 20: Temperature Reset Table in Plant Graphic - Example

- M. Power meters – Pertinent values for each power meter should be displayed in a table. The table should display at minimum phase voltage, total power, and total energy for each channel measured. Where multiple circuits are metered within a building, one-line riser or tree shall display the kW and kWh of each circuit with descriptions of each circuit displayed.

Panel "MDP" Points Room 121		Panel "R2" Points Room 121		Panel "M" Points Room 120		Panel "R1" Points Room 120		Panel "L1" Points Room 120	
Current A	26.63	Current A	0.24	Current A	3.68	Current A	0.00	Current A	22.19
Current B	30.26	Current B	0.06	Current B	1.54	Current B	0.00	Current B	24.71
Current C	9.59	Current C	0.36	Current C	2.51	Current C	0.00	Current C	0.90
Voltage A	216.75	Voltage A	216.93	Voltage A	216.81	Voltage A	0.00	Voltage A	216.26
Voltage B	216.32	Voltage B	216.44	Voltage B	216.26	Voltage B	0.00	Voltage B	216.32
Voltage C	216.20	Voltage C	216.38	Voltage C	216.26	Voltage C	0.00	Voltage C	216.08
Voltage L-NV	124.95	Voltage L-NV	125.62	Voltage L-NV	125.00	Voltage L-NV	0.00	Voltage L-NV	124.81
Real Power	8.28	Real Power	0.04	Real Power	0.64	Real Power	0.00	Real Power	5.95
Energy Div	215,591.36	Energy Div	1,485.39	Energy Div	57,937.13	Energy Div	13,830.75	Energy Div	82,809.61
Frequency	60.00	Frequency	60.00	Frequency	60.00	Frequency	0.00	Frequency	60.00

Figure 21: Power Meter Graphic Example

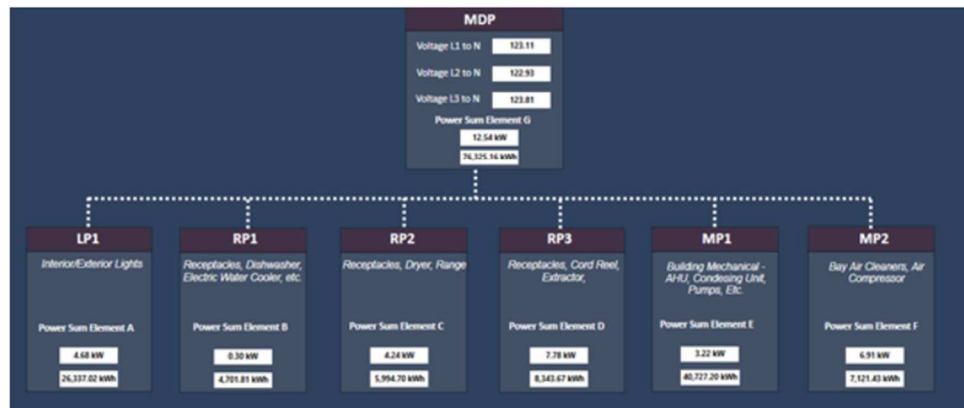


Figure 22: Power Meter - Riser/Tree Example

4.4 Wake County GSA BMS Naming Convention

- A. All physical and virtual points as well as equipment should follow the point naming convention. Both name and description should be completed to allow for quick identification of point, location and purpose. Where possible, points should be case sensitive to follow the naming convention.

B. Single Equipment Points

Example:

BACnet Name: 149ERL.01.AHU01.SAFanEnbl

BACnet Description: 149ERL – AHU01 Supply Fan Enable

Where: 149 = Building Number;

ERL = Building Acronym;

01 = Floor Number

AHU = Equipment Type; See Table

01 = Equipment Number

SAFan = Component;

Enbl = Measurement/Control

C. Terminal Box / VAV Points

Examples:

BACnet Name: 149ERL.02.AHU02.TBP15.FanEnbl

BACnet Description: 149ERL – Terminal Box 15 – Fan Enable

Where: 149 = Building Number; see key

ERL = Building Acronym; see key

02 = Floor Number

AHU02 = Air Handler Number

TBP = Terminal Box: Parallel

15 = Terminal Box Number

FanEnbl = Measurement/Control (TEC fan control)

BACnet Name: 149ERL.03.AHU01.VAV08.DmprCtl

BACnet Description: 149ERL – VAV08 – Damper Control

Where: 149 = Building Number; see key

ERL = Building Acronym; see key

02 = Floor Number

AHU01 = Air Handler Number

VAV = VAV Box

08 = VAV Box Number

DmprCtl = Measurement/Control (TEC Damper control)

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D. Building floor level designations for BMS points:

PD	Pod
DM	Dorm
0B	Basement
0G	Ground
0M	Main
1	First
MZ	Mezzanine
2	Second
3	Third
4	Fourth

5	Fifth
6	Sixth
7	Seventh
8	Eighth
9	Ninth
10	Tenth
11	Eleventh and so on

E. Acronyms for Equipment Type

Equipment Type	Equipment Description
AHU	Air Handling Unit
Blr	Boiler
Dmpr	Damper
CU	Condensing Unit
Chem	Chemical Feeder
Chlr	Chiller
CT	Cooling Tower
DetHtr	Duct Heater, Electric
FireDoor	Fire Door
Gen	Emergency Generator
Evap	Evaporator Coil
DX	Direct Expansion Cooling Circuit
ExFan	Exhaust Fan
EXH	Exhaust Hood
ExtLgt	Exterior Lighting
IntLgt	Interior Lighting
FACP	Fire Alarm Panel
FCU	Fan Coil Unit
FDmpr	Fire Damper
HP	Heat Pump
HX	Heat Exchanger

Equipment Type	Equipment Description
HVAC	Heating Vent./Ac System
SumpLvl	Sump Level Sensor
Pmp	Pump
StairFan	Stair Pressurization Fan
PRV	Pressure Reducing Valve
RAFan	Return Air Fan
RTU	Rooftop Unit
SAFan	Supply Air Fan
SmkDmpr	Smoke Damper
SumpPmp	Sump Pump
FPBP	Fan Powered Box / Terminal Box (Parallel)
FPBS	Fan Powered Box / Terminal Box (Series)
Tnk	Tank
ATS	Automatic Transfer Switch
UH	Unit Heater
UPS	Uninterruptable Power Supply
VAV	Variable Air Volume Box
VFD	Variable Frequency Drive
PTAC	Wall A/C
WH	Water Heater
Smk	Smoke Detector

F. Acronyms for Components & Measurement/Control

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Component Name	Component Description
Econ	Economizer
CO2	Carbon Dioxide
CdW	Condenser Water
Chlr	Chiller
ChW	Chilled Water
ChWS	Chilled Water System
Coil	Coil
SA	Supply Air
RA	Return Air
MA	Mixed Air
EA	Exhaust Air
OA	Outside Air
Pht	Preheat
S	Supply (Water)
R	Return (Water)
DX	DX Cooling Stage
CT	Cooling Tower
CoolCoil	Cooling Coil
EOL	End of Line
FrzStat	Freezestat
Flm	Flame
Fltr	Filter
Gas	Natural Gas
Elec	Electric
Heat	Heating
Vib	Vibration
IsoVlv	Isolation Valve
MkUp	Make Up (Water)
HeatCoil	Heating Coil
Hum	Humidity
HW	Hot Water
HWS	Hot Water System
Rht	Reheat
Rm	Room
Spc	Space
Stm	Steam
Smk	Smoke
LPStm	Low Pressure Steam

Measurement/Control	Measurement/Control Description
Cap	Capacity
Tmp	Temperature
SP	Setpoint
TmpSP	Temperature Setpoint
STmp	Supply Temp
RTmp	Return Temp
STmpSP	Supply Temp Setpoint
Enbl	Enable
Stat	Status
Alm	Alarm
Amp	Amps
Flow	Air/Water Flow
RFlow	Return Flow
SFlow	Supply Flow
PosFdBck	Position Feedback
Ctl	Control Signal
OnSP	On Setpoint
Req	System Request/Enable (AHU/Chilled Water System/Hot Water System)
DP	Differential Pressure
Enth	Enthalpy
FireRate	Boiler Flame Control
DewPt	Dew Point
Prs	Pressure
Spd	Speed – Control
SpdFdBck	Speed – Feedback from VFD
Hi	High Speed
Lo	Low Speed
StaticPrs	Static Pressure
StaticPrsSP	Static Pressure Setpoint
kW	Kilowatts
kWh	Kilowatt Hours

G. Acronyms for Subcomponents

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Component Name	Component Description
Vlv	Valve
Byp	Bypass
Pmp	Pump
Dmpr	Damper
Dmd	Demand
Fan	Fan
Dehum	Dehumidification Equipment/Sequence
EndSwitch	End Switch
Lo	Low
Hi	High
Pre	Pre (before)
Pwr	Power

H. Combined Examples of Components, Subcomponents and Measurement/Control

ChWVlv	Chilled Water Valve
ChWRFlow	Chiller Water Return Flow
ChWRTmp	Chilled Water Return Temp
ChWSPump	Chiller Water Supply Pump
ChWSTmp	Chilled Water Supply Temp
ChWSTmpSP	Chilled Water Supply Temp Setpoint
CTBypVlv	Cooling Tower Bypass Valve
CoolCoilTmp	Cooling Coil Temperature
DmprCtl	Damper Control
DmprPosFdBck	Damper Position Feedback
EconDmpr	Economizer Damper
EOLPrs	End of Line Pressure
FltrStat	Filter DP (Clean/Dirty) Status
FltrDP	Filter DP (Measurement)
GasFlow	Natural Gas Flow Rate
CTVibAlm	Cooling Tower Vibration Alarm
PreFltrDP	Pre Filter Differential Pressure
MkUpVlv	Make Up Water Valve
HiLvlAlm	High Level Alarm
SAHiTmpAlm	Supply Air High Temperature Alarm
LPStmVlv	Low Pressure Steam Valve
HiStatPrsAlm	High Static Pressure Alarm
OATmp	Outside Air Temp

I. Table of Example of Point Names

Point	Building Number	Building Acronym	Floor	BACnet Name	BACnet Description

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Chilled Water System - System Request/Enable/OnOff	076	ORL	1	076ORL.01.ChWS.SysReq	076ORL - Chilled Water System Request
Chilled Water System - Demand (tons)	076	ORL	1	076ORL.01.ChWS.SysDemand	076ORL - Chilled Water System Demand (tons)
Chilled Water System - Available Running Chiller Capacity	076	ORL	1	076ORL.01.ChWS.SysCap	076ORL - Chilled Water System Capacity (tons)
Chilled Water System - Chilled Water Pump 1 - Enable/OnOff	076	ORL	1	076ORL.01.ChWS.ChWPmp1Enbl	076ORL - Chilled Water Pump 1 - Enable
Chilled Water System - Chilled Water Pump 1 - Status	076	ORL	1	076ORL.01.ChWS.ChWPmp1Stat	076ORL - Chilled Water Pump 1 - Status
Chilled Water System - Chilled Water Pump 1 - Speed	076	ORL	1	076ORL.01.ChWS.ChWPmp1Spd	076ORL - Chilled Water Pump 1 - Speed
Chilled Water System - Chilled Water Pump 1 - Alarm	076	ORL	1	076ORL.01.ChWS.ChWPmp1Alm	076ORL - Chilled Water Pump 1 - Alarm
Chilled Water System - Chilled Water Pump 1 - Flow Meter on Pump	076	ORL	1	076ORL.01.ChWS.ChWPmp1Flow	076ORL - Chilled Water Pump 1 - Flow Meter on Pump
Chilled Water System - Secondary Chilled Water Pump 2 - Enable/OnOff *Others named in similar manor	076	ORL	1	076ORL.01.ChWS.ChWPmp2Enbl	076ORL - Secondary Chilled Water Pump 2 - Enable
Chilled Water System - Secondary Loop Differential Pressure	076	ORL	1	076ORL.01.ChWS.SecDP	076ORL - Chilled Water Secondary Loop Differential Pressure
Chilled Water System - Secondary Loop Differential Pressure - Setpoint	076	ORL	1	076ORL.01.ChWS.SecDPSP	76ORL - Chilled Water Secondary Loop Differential Pressure - Setpoint
Chilled Water System - Secondary Loop Supply Temperature	076	ORL	1	076ORL.01.ChWS.SecSTmp	076ORL - Chilled Water Secondary Loop Supply Temperature
Chilled Water System - Secondary Loop Return Temperature	076	ORL	1	076ORL.01.ChWS.SecRTmp	076ORL - Chilled Water Secondary Loop Return Temperature
Chilled Water System - Chiller 1 - Enable/Request	076	ORL	1	076ORL.01.ChWS.Chlr1Enbl	076ORL - Chiller 1 - Enable
Exhaust Fan 1 - Enable/Start	076	ORL	1	076ORL.01.EXF01.Enbl	076ORL - Exhaust Fan 1 - Enable/Start
Exhaust Fan 1 - Status	076	ORL	1	076ORL.01.EXF01.Stat	076ORL - Exhaust Fan 1 - Status
VAV #03 - Fed from AHU01 - Damper Position Feedback	076	ORL	1	076ORL.01.AHU01.VAV03.Dmpr PosFdBck	76ORL - VAV03 - Damper Position Feedback
VAV #03 - Fed from AHU01 - Damper Control	076	ORL	1	076ORL.01.AHU01.VAV03.Dmpr Ctl	76ORL - VAV03 - Damper Control Signal
VAV #03 - Fed from AHU01 - Valve Control	076	ORL	1	076ORL.01.AHU01.VAV03.VlvCt 1	76ORL - VAV03 - Valve Control
VAV #03 - Fed From AHU01 - Air Flow	076	ORL	1	076ORL.01.AHU01.VAV03.Flow	76ORL - VAV03 - Primary Air Flow

J. Controller Device Name

1. Equipment named after primary control purpose. Where multiple systems are served, the controller model can be referenced. BACnet Descriptions must be assigned.

Example:

BACnet Name: 149ERL.01.AHU01

BACnet Description: 149ERL – AHU 1 Controller

Where: 149 = Building Number;

ERL = Building Acronym;

01 = Floor Number

AHU = Primary Equipment Served

01 = Equipment Number

Example: Variable Frequency Drive

BACnet Name: 149ERL.01.AHU01.SAFan_VFD

BACnet Description: 149ERL – AHU1 Supply Fan VFD

BACnet Name: 076ORL.01.ChWS.CdWPmp_VFD

BACnet Description: 076ORL – Chilled Water System Cond. Pump VFD

Example: VAV

BACnet Name: 149ERL.01.AHU01.VAV08

Example: Controlling two AHUs

BACnet Name: 149ERL.01.AHU01_AHU02

Example: Controlling Multiple Systems:

Example: Schneider ASP

BACnet Name: 149ERL.01.ASP01

Example: Siemens PXCM

BACnet Name: 149ERL.01.PXCM01

Example: JACE

BACnet Name: 149ERL.01.JACE01

Example: Terminal Box

Equipment Name: 149ERL.02.TBP15

Where: 149 = Building Number; see key

ERL = Building Identifier; see key

02 = Floor Number

TBP = Terminal Box: Parallel

15 = Terminal Box Number

K. Wake County GSA BMS BACnet Instance Naming Convention

1. BACnet Instance Numbers 1 to 4194302 (7 digits)

Wake County – Building Name and Number Submittal

Controls Contractor		GSA
Building Name		
Building Number		

Wake County BACnet Instance Number Submittal

Controls Contractor	
Building Name	
Building Number	

Graphics Contractor

Device Description	Device Model	BACnet Name	BACnet Description	BACnet Instance Number
Example: AHU1 Controller	PXCM	149ERL.01.AHU01	149ERL – AHU 1	1491100
Example: VAV1 Served by AHU1	DXR	149ERL.01.AHU01.VAV01	149ERL – AHU1 – VAV1	1491101

END OF SECTION 230900

SECTION 230993 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUMMARY

- A. This Section includes control sequences for HVAC systems, subsystems, and equipment.
- B. Related Sections include the following:
 - 1. Division 23 Section "Building Automation System" for control equipment and devices and for submittal requirements.

1.3 DEFINITIONS

- A. BAS: Building automation system.
- B. CO₂: Carbon dioxide.
- C. CO: Carbon monoxide
- D. DDC: Direct digital control.
- E. PPM: Parts per million.
- F. RPM: Revolutions per minute.
- G. SCR: Silicon-Controlled Rectifier.
- H. TAB: Testing, Adjusting and Balancing.
- I. VAV: Variable air volume.
- J. VFD: Variable-frequency drive

1.4 SYSTEM DESCRIPTION

- A. The systems controlled under work of this section basically comprise the exhaust fans and integration into the existing building automation system and air handling unit control systems. The smoke control system shall integrate to the existing building automation system.

- B. This Section defines the manner and method by which controls function.

1.5 SUBMITTALS

- A. Refer to Section "Building Automation System."
- B. Programming Manual: Provide DDC system programming manual as well as documentation of site-specific programming prior to the start of construction.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 GENERAL

- A. Sequences specified herein indicate the functional intent of the systems operation and may not fully detail every aspect of the programming that may be required to obtain the indicated operation. Contractor shall provide all programming necessary to obtain the sequences/system operation indicated.
- B. Except as specified otherwise, throttling ranges, proportional bands, and cycle differentials shall be centered on the associated setpoint. All modulating feedback control loops shall include the capability of having proportional, integral, and derivative action. Unless the loop is specified "proportional only" or "P+I", Contractor shall apply appropriate elements of integral and derivative gain to each control loop which shall result in stable operation, minimum settling time, and shall maintain the primary variable within the specified maximum allowable variance.
- C. Provide a real time clock and schedule controller with sufficient scheduling capability to schedule all required controllers and sequences. Set up initial schedules in coordination with Wake County.
- D. Wherever a value is indicated as adjustable (adj.), it shall be modifiable, with the proper password level, from the Operator interface. For these points, it is unacceptable to have to modify programming statements to change the setpoint.
- E. Where "prove operation" of a device (generally controlled by a digital output) is indicated in the sequence, it shall require that the BAS shall, after an adjustable time delay after the device is commanded to operate (feedback delay) , confirm that the device is operational via the status input. If the status point does not confirm operation after the time delay or anytime thereafter for an adjustable time delay (debounce delay) while the device is commanded to run, an alarm shall be enunciated audibly. Upon failure, run command shall be removed and the device shall be locked out until the alarm is manually acknowledged unless specified otherwise.

- F. BAS shall provide for adjustable maximum rates of change for increasing and decreasing output from the following analog output points:
 - 1. Speed control of variable speed drives
 - 2. Control Reset Loop
 - 3. Valve Travel Limit
- G. Wherever a value is indicated to be dependent on another value (i.e.: setpoint plus 5°F) BAS shall use that equation to determine the value. Simply providing a virtual point that the operator must set is unacceptable. In this case three virtual points shall be provided. One to store the parameter (5°F), one to store the setpoint, and one to store the value which is the result of the equation.
- H. VFD Interface: BAS shall monitor the VFD via a direct interface. All available information shall be accessible via the interface for display on the VFD graphic. The VFD Alarm point shall be displayed on the main graphic and shall be alarmed via the BAS. All other points may be displayed on a separate graphic that is selected from this system's graphic. Reference the VFD chart on the project plans for additional information on points that should be hardwired versus integrated through a direct interface.
- I. All actuators for valves and dampers should be scaled within the controller to operate 0% = closed and 100% = open.
- J. All programming timers should be assigned variables for real-time troubleshooting.
- K. Programming should include adequate comments in order to understand which sections of code perform specific functions.
- L. AHU shall be programming with a separate "AHU Enable" and "Occupancy Mode" points. AHU Enable points shall shut the AHU down without the possibility of operation except life safety operation.
- M. AHU controller should send occupancy points to VAV controllers. AHU should receive schedule command. While in unoccupied mode, AHU should either poll VAV boxes or receive call from VAV boxes to start and maintain setpoints.

3.2 FIREFIGHTERS SMOKE CONTROL PANEL

- A. BAS shall allow manual control of all equipment utilized for smoke control from the Firefighters Smoke Control Panel. The fire fighter's smoke control panel shall include manual control override of automatic smoke control operation. The panel should be located in the central control office adjacent to the fire alarm panel. Refer to Fire Alarm/Smoke Control Matrix on drawings for additional details.
- B. Fans within the building shall be shown on the fire fighter's control panel. A clear indication of the direction of airflow and the relationship of components shall be displayed. Status indicators shall be provided for all smoke control equipment, annunciated by fan and zone, and by pilot-lamp-type indicators as follows:
 - 1. Fans, dampers and other operating equipment in their normal status—WHITE.
 - 2. Fans, dampers and other operating equipment in their off or closed status—RED.

3. Fans, dampers and other operating equipment in their on or open status—GREEN.
 4. Fans, dampers and other operating equipment in a fault status—YELLOW/AMBER.
- C. The fire fighter's control panel shall provide control capability over the complete smoke control system equipment within the building as follows:
1. ON-AUTO-OFF control over each individual piece of operating smoke control equipment that can also be controlled from other sources within the building. This includes stairway pressurization fans; smoke exhaust fans; supply, return and exhaust fans; elevator shaft fans and other operating equipment used or intended for smoke control purposes.
 2. OPEN-AUTO-CLOSE control over individual dampers relating to smoke control and that are also controlled from other sources within the building.
 3. ON-OFF or OPEN-CLOSE control over smoke control and other critical equipment associated with a fire or smoke emergency and that can only be controlled from the fire fighter's control panel.
- D. The fire-fighter's control panel actions shall be as follows:
1. ON-OFF and OPEN-CLOSE control actions shall have the highest priority of any control point within the building. Once issued from the fire fighter's control panel, automatic or manual control from any other control point within the building shall not contradict the control action. Where automatic means are provided to interrupt normal, nonemergency equipment operation or produce a specific result to safeguard the building or equipment including, but not limited to, duct freezestats, duct smoke detectors, high-temperature cutouts, temperature-actuated linkage and similar devices, such means shall be capable of being overridden by the fire fighter's control panel. The last control action as indicated by each fire fighter's control panel switch position shall prevail. Control actions shall not require the smoke control system to assume more than one configuration at any one time.
 2. Only the AUTO position of each three-position fire-fighter's control panel switch shall allow automatic or manual control action from other control points within the building. The AUTO position shall be the NORMAL, nonemergency, building control position. Where a fire fighter's control panel is in the AUTO position, the actual status of the device (on, off, open, closed) shall continue to be indicated by the status indicator described above. Where directed by an automatic signal to assume an emergency condition, the NORMAL position shall become the emergency condition for that device or group of devices within the zone. Control actions shall not require the smoke control system to assume more than one configuration at any one time.
- 3.3 SINGLE ZONE VAV AHU WITH PREHEAT, CHILLED WATER & REHEAT COILS SERVING DORMITORIES (AHU-1 thru AHU-6)
- A. Refer to PHASE 1 project for full AHU sequences of operation. All AHU sequences are existing to remain except for smoke control sequences and the addition of a space temperature sensor.
- B. Space Temperature Sensor: A space temperature sensor shall be added to the guard station. The space temperature sensor shall have setpoint override. The AHU programming shall be revised to control temperature to the space temperature sensor in lieu of the return duct temperature sensor.

- C. Smoke Control Details: Refer to Fire Alarm/Smoke Control Matrix on drawings for additional details.
 - D. Smoke Control Mode: Upon indication of smoke in the return airstream via the BAS alarm signal from the duct smoke detector or a zone smoke signal from the fire alarm panel.
 - 1. The low limit control is ignored.
 - 2. The alarmed air handling unit supply fan is energized and set to its prescribed fan speed (as determined during Testing and Balancing for maintaining the differential pressure at the smoke zone doors.).
 - 3. The associated smoke evacuation fan(s) smoke dampers and associated fans shall energize. Refer to Exhaust Fan (Smoke Control) for additional details.
 - 4. All exhaust fans and air handling units within the smoke zone shall be enabled upon smoke in any of the return duct sensors or any of the area smoke detectors or upon a signal from the fire alarm system for a smoke detector in that smoke zone.
 - 5. All other zones shall remain under normal operation.
 - E. Monitoring:
 - 1. Voltage sensing relays. The BAS shall monitor voltage sensing relays that are downstream of the last disconnect, but prior to the motor starter, VFD or damper motor for all fans and dampers. The BAS shall monitor these and produce a report weekly for any equipment that doesn't have power. An alarm shall be generated at the head end.
 - 2. Each damper shall have end switches for open/closed. During smoke control mode, if the damper actual position is not in the correct position after 15 seconds, than an alarm shall be sent to the head end and the fault light shall be displayed on the firefighter's smoke control panel.
 - 3. Fan pressure switch. Each fan shall be equipped with static pressure switch for proving fan airflow. This shall be used as the status for each fan. If the fan is not producing the static pressure (as determined during TAB, set to 10% below static pressure recorded during TAB) after 30 seconds of commanded fan operation, than an alarm shall be sent to the head end and the fault light shall be displayed on the firefighter's smoke control panel.
- 3.4 VAV AHU WITH PRE-HEAT & CHILLED WATER COILS SERVING TERMINAL UNITS (AHU-7 &8) (SMOKE CONTROL SEQUENCE ONLY)
- A. Refer to PHASE 1 project for full AHU sequences of operation. All AHU sequences are existing to remain except for smoke control sequences.
 - B. Smoke Control Details: Refer to Fire Alarm/Smoke Control Matrix on drawings for additional details.
 - C. Smoke Control Mode: Upon indication of smoke in the return airstream via the BAS alarm signal from the duct smoke detector or a zone smoke signal from the fire alarm panel.
 - 1. The low limit control is ignored.
 - 2. The alarmed air handling unit supply fan is energized and set to its prescribed fan speed (as determined during Testing and Balancing for maintaining the differential pressure at the smoke zone doors.).
 - 3. The associated smoke evacuation fan(s) smoke dampers and associated fans shall energize. Refer to Exhaust Fan (Smoke Control) for additional details.

4. All exhaust fans and air handling units within the smoke zone shall be enabled upon smoke in any of the return duct sensors or any of the area smoke detectors or upon a signal from the fire alarm system for a smoke detector in that smoke zone.
5. All other zones shall remain under normal operation.

D. Monitoring:

1. Voltage sensing relays. The BAS shall monitor voltage sensing relays that are downstream of the last disconnect, but prior to the motor starter, VFD or damper motor for all fans and dampers. The BAS shall monitor these and produce a report weekly for any equipment that doesn't have power. An alarm shall be generated at the head end.
2. Each damper shall have end switches for open/closed. During smoke control mode, if the damper actual position is not in the correct position after 15 seconds, than an alarm shall be sent to the head end and the fault light shall be displayed on the firefighter's smoke control panel.
3. Fan pressure switch. Each fan shall be equipped with static pressure switch for proving fan airflow. This shall be used as the status for each fan. If the fan is not producing the static pressure (as determined during TAB, set to 10% below static pressure recorded during TAB) after 30 seconds of commanded fan operation, than an alarm shall be sent to the head end and the fault light shall be displayed on the firefighter's smoke control panel.

3.5 VAV RTU WITH PRE-HEAT & CHILLED WATER COILS, RETURN FAN (RTU-1) (SMOKE CONTROL SEQUENCE ONLY)

- A. Refer to PHASE 1 project for full AHU/RTU sequences of operation. All AHU/RTU sequences are existing to remain except for smoke control sequences.
- B. Smoke Control Details: Refer to Fire Alarm/Smoke Control Matrix on drawings for additional details.
- C. Smoke Control Mode: Upon indication of smoke in the smoke zone 1 from the fire alarm panel.
 1. The air handling unit (RTU-1) is disabled. The supply and return fans shall be disabled. The associated dampers shall close.
 2. The associated smoke evacuation fan(s) smoke dampers and associated fans shall energize. Refer to Exhaust Fan (Smoke Control) for additional details.
 3. The associated smoke evacuation gravity intake ventilator damper shall open (D-IH-1). The BAS shall confirm that the damper is fully open. The damper shall display a fault if it is not fully open when the smoke zone is in smoke control mode. The damper shall display a fault if the damper is not closed, when the smoke zone is commanded off. An alarm shall be generated on the BAS head end if the damper is open when it is not in smoke control mode.
 4. All other zones shall remain under normal operation.

3.6 TERMINAL UNIT WITH HOT WATER HEATING COIL (AHU-7 & 8 only) (SMOKE CONTROL SEQUENCE ONLY)

- A. Refer to PHASE 1 project for full terminal unit sequences of operation. All terminal unit sequences are existing to remain except for smoke control sequences.

- B. Smoke Control Details: Refer to Fire Alarm/Smoke Control Matrix on drawings for additional details.
 - C. Smoke Control Mode: Upon indication of smoke in the return airstream via the BAS alarm signal from the duct smoke detector or a zone smoke signal from the fire alarm panel.
 - 1. The low limit control is ignored.
 - 2. The alarmed air handling unit supply fan is energized and set to its prescribed fan speed (as determined during Testing and Balancing for maintaining the differential pressure at the smoke zone doors.).
 - 3. The associated smoke evacuation fan(s) smoke dampers and associated fans shall energize. Refer to Exhaust Fan (Smoke Control) for additional details.
 - 4. All exhaust fans and air handling units within the smoke zone shall be enabled upon smoke in any of the return duct sensors or any of the area smoke detectors or upon a signal from the fire alarm system for a smoke detector in that smoke zone.
 - 5. All other zones shall remain under normal operation.
- 3.7 SINGLE DUCT VAV AHU WITH PRE-HEAT & CHILLED WATER COILS (SMOKE CONTROL SEQUENCE ONLY)
- A. Refer to PHASE 1 project for full AHU sequences of operation. All AHU sequences are existing to remain except for smoke control sequences.
 - B. Smoke Control Details: Refer to Fire Alarm/Smoke Control Matrix on drawings for additional details.
 - C. Smoke Control Mode: Upon indication of smoke in the return airstream via the BAS alarm signal from the duct smoke detector or a zone smoke signal from the fire alarm panel.
 - 1. The low limit control is ignored.
 - 2. The alarmed air handling unit supply fan is energized and set to its prescribed fan speed (as determined during Testing and Balancing for maintaining the differential pressure at the smoke zone doors.).
 - 3. The associated smoke evacuation fan(s) smoke damper and associated fans shall energize. Refer to Exhaust Fan (Smoke Control) for additional details.
 - 4. All exhaust fans and air handling units within the smoke zone shall be enabled upon smoke in any of the return duct sensors or any of the area smoke detectors or upon a signal from the fire alarm system for a smoke detector in that smoke zone.
 - 5. The terminal unit dampers shall be fully opened, or set to a predetermined set position as required to maintain static pressure differential setpoints during testing and balancing and commissioning of smoke control system.
 - D. Monitoring:
 - 1. Voltage sensing relays. The BAS shall monitor voltage sensing relays that are downstream of the last disconnect, but prior to the motor starter, VFD or damper motor for all fans and dampers. The BAS shall monitor these and produce a report weekly for any equipment that doesn't have power. An alarm shall be generated at the head end.
 - 2. Each damper shall have end switches for open/closed. During smoke control mode, if the damper actual position is not in the correct position after 15 seconds, than an alarm shall be sent to the head end and the fault light shall be displayed on the firefighter's smoke control panel.

3. Fan pressure switch. Each fan shall be equipped with static pressure switch for proving fan airflow. This shall be used as the status for each fan. If the fan is not producing the static pressure (as determined during TAB, set to 10% below static pressure recorded during TAB) after 30 seconds of commanded fan operation, than an alarm shall be sent to the head end and the fault light shall be displayed on the firefighter's smoke control panel.

3.8 EXHAUST FAN (Smoke Control)

- A. Smoke Control Details: Refer to Fire Alarm/Smoke Control Matrix on drawings for additional details.
- B. General: These fans are for smoke exhaust and are activated by a fire alarm signal or manually by the Firefighters Smoke Control Panel. Refer to the Fan Schedule for fan information.
- C. Start:
 1. Upon a signal from the fire alarm that the smoke zone has detected smoke or by a manual selection to start from the Firefighters Smoke Control Panel, the damper shall be commanded open. At the start of occupied operation, the BAS shall open the motorized damper associated with the fan. Once the damper is confirmed open, the BAS shall start the fan.
- D. Stop:
 1. Upon the Firefighters Smoke Control Panel override being switched to the off position or the fire alarm clearing the smoke in the zone, the fan should be disabled. The BAS shall stop the fan and close the associated damper.
- E. Monitoring:
 1. Voltage sensing relays. The BAS shall monitor voltage sensing relays that are downstream of the last disconnect, but prior to the motor starter, VFD or damper motor for all fans and dampers. The BAS shall monitor these and produce a report weekly for any equipment that doesn't have power. An alarm shall be generated at the head end.
 2. Each damper shall have end switches for open/closed. During smoke control mode, if the damper actual position is not in the correct position after 15 seconds, than an alarm shall be sent to the head end and the fault light shall be displayed on the firefighter's smoke control panel.
 3. Fan pressure switch. Each fan shall be equipped with static pressure switch for proving fan airflow. This shall be used as the status for each fan. If the fan is not producing the static pressure (as determined during TAB, set to 10% below static pressure recorded during TAB) after 30 seconds of commanded fan operation, than an alarm shall be sent to the head end and the fault light shall be displayed on the firefighter's smoke control panel.

3.9 FAN (Control Method BAS Schedule)

- A. General: These are general duty fans which operate on a time-of-day schedule. Refer to the Fan Schedule for fan information.

- B. Occupied/Unoccupied:
 - 1. Unoccupied Operation: During unoccupied hours the fan shall be off and the damper shall be closed.
 - 2. Occupied Operation: During occupied hours, the fan shall be on and the damper shall be open.
- C. Start:
 - 1. At the start of occupied operation, the BAS shall open the motorized damper associated with the fan. Once the damper is confirmed open, the BAS shall start the fan. If the damper is interlocked with fan operation, then the BAS shall start the fan.
- D. Stop:
 - 1. At the beginning of unoccupied operation, the BAS shall stop the fan and close the associated damper (or just stop the fan if the damper is interlocked).
- E. Fan failure alarm:
 - 1. If the fan fails to start (as sensed by its current sensing relay) an alarm shall be sent to the head end identifying the fan and stating that it has failed to start.

3.10 COMPUTER ROOM AIR CONDITIONING UNITS

- A. These units provide space temperature and humidity control for the Central Control room and security electronics.
- B. Each unit shall operate on its' factory-installed control system. The unit will be equipped with a remote, field-installed, space temperature sensor and a space humidity sensor. The BAS contractor shall provide all wiring and miscellaneous hardware to install these components and interface them between the Evaporator/Air Handler and the Condenser unit. The factory mounted controls shall include a BACnet IP interface for monitoring by the BAS. At a minimum, the BACnet IP interface shall provide the following data to the BAS head end. The following points shall be R/W are read/write points, RD are read only points.
 - 1. Space Air Temperature Setpoint (R/W)
 - 2. Space Humidity Setpoint (R/W)
 - 3. Supply Air Temperature (RD)
 - 4. High Space Temperature Alarm (R/W)
 - 5. Low Space Temperature Alarm (R/W)
 - 6. High Space Humidity Alarm (R/W)
 - 7. Low Space Humidity Alarm (R/W)
 - 8. Humidifier Utilization (RD)
 - 9. Dehumidifier Utilization (RD)
 - 10. Cooling Capacity (RD)
 - 11. Chilled Water Valve Position (RD)
 - 12. Electric Heating Capacity (RD)
- C. Each CRAC unit is to be monitored by the BAS. The BAS contractor shall install an appropriate controller for each CRAC unit to provide the following BAS monitoring points.
 - 1. Space Temperature

- 2. Space Humidity
- 3. CRAC Alarm

- D. The contractor shall inspect the entire piece of equipment, including all coils, valves and operators to ensure their proper operation and condition. Report any deficiencies to the Architect and Owner.
- E. The BAS contractor shall furnish and install Condensate Overflow Safety controllers as specified in 3.7, I.
 - 1. Wire the alarm contacts to the BAS input for monitoring and alarming.
- F. The BAS controller installation shall include all power and control wiring for the controller and any required terminations.
- G. The contractor shall provide a NEMA 1 enclosure with a hinged cover. This panel shall contain the BAS controller and other interface components. Mounting location is to be wall mounted adjacent to the indoor unit.

3.11 DRYER LINT MONITORING

- A. The BAS shall monitor each dryer through a current sensing switch. If the dryer is in operation as indicated by the CSR being within the operating amps of the dryer, then the BAS shall monitor the dryer vent static pressure. If the dryer vent drops below 75% of the total static pressure (as determined during TAB with the dryer in operation and the ductwork clean), then the BAS shall have an alarm to "Clean Dryer Vent".

3.12 EMERGENCY GENERATOR POWERING

- A. Provide for provisions for unit operation when the facility loses power and is on emergency (generator) power. Coordinate with electrical the serving of units on emergency power.

3.13 TRANSFER SWITCH MONITORING

- A. Provide monitoring of the transfer switch. The BAS shall report on the head end whether the transfer switch is in normal power or emergency generator power.

3.14 MORGUE TRAILER TEMPERATURE MONITORING

- A. The building automation system shall have two (2) temperature sensors in each trailer at opposite ends of the trailer for temperature monitoring. Should the temperature either rise above the maximum setpoint of 42° F (adj.) or fall below 32°F (adj) than an alarm shall be sent to the head end.

3.15 HVAC EMERGENCY STOP BUTTON

- A. A manual override of each AHU shall be provided as part of the firefighters smoke control manual. The firefighters smoke control panel shall override all other commands.

3.16 FIRE ALARM MONITORING

- A. The BAS shall monitor a set of dry contacts on the fire alarm system. When the fire alarm system issues an alarm, it shall be forwarded to the BAS head end. Provide a graphic with the alarm status on the head end graphics. The BAS shall monitor the smoke control zone initiation for all smoke zones. Should the fire alarm indicate that there is smoke in any of the smoke compartments, than that compartment shall be commanded into automatic smoke control mode for that zone.

3.17 DOMESTIC HOT WATER:

- A. The BAS shall monitor the temperature of the domestic hot water systems (temperature of water leaving the thermostatic mixing valve assembly) and shall issue an alarm to the head end if the temperature is more than 10° above or below set point. Alarm shall be disabled during unoccupied time periods and shall be enabled 1 hour after occupancy.

3.18 DOMESTIC HOT WATER PUMP (TYPICAL EACH CIRCULATING PUMP)

- A. During occupied hours, the BAS shall command the pump on.
- B. During unoccupied hours, the BAS shall command the pump off.
- C. Should the pump fail to run (as sensed by the current sensing relay), an alarm shall be sent to the head end identifying the pump and stating that it has failed.

PART 4 - EXECUTION (Not Applicable)

END OF SECTION 230993

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Pipe.
 - 2. Fittings.
 - 3. Joining materials.
 - 4. Bypass chemical feeder.
 - 5. Valves-Include flow and pressure drop curves/information based on manufacturer's testing for calibrated-orifice balancing valves.
 - 6. Air control devices.
 - 7. Chemical treatment.
 - 8. Hydronic specialties.
- B. Maintenance Data: For hydronic specialties, balancing valves, and special-duty valves to include in maintenance manuals.

1.3 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 the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

1.4 COORDINATION

- A. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Coordinate pipe sleeve installations for foundation wall penetrations.
- C. Coordinate piping installation with roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 7 Sections.
- D. Coordinate pipe fitting pressure classes with products specified in related Sections.

- E. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.
- F. Coordinate installation of pipe sleeves for penetrations through exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 7 Section "Penetration Firestopping Systems" for fire and smoke wall and floor assemblies.

1.5 BUILDING AUTOMATION SYSTEM COORDINATION:

- A. If indicated, all wells, valves, taps, dampers, flow stations, etc. furnished under Section "Building Automation System" shall be installed under this Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Hydronic piping, components, and installation shall withstand the following minimum working pressure and temperature unless otherwise indicated: 150 psig at 200 degrees F.

2.2 COPPER TUBE AND FITTINGS

- A. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
- B. DWV Copper Tubing: ASTM B 306, Type DWV.
- C. Wrought-Copper Fittings and Unions: ASME B16.22.

2.3 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in "Piping Applications" Article.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping Applications" Article.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.
- F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

- G. 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.
- H. Flexible Connectors: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket; 150-psig minimum working pressure and 250 deg F maximum operating temperature. Connectors shall have flanged or threaded-end connections to match equipment connected and shall be capable of 3/4-inch misalignment.
- I. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.4 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 maximum thickness unless otherwise 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: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer 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 joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
- F. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.5 DIELECTRIC FITTINGS

- A. Where piping of dissimilar metals is joined together use yellow brass unions.

2.6 VALVES

- A. Valves are specified in Division 23 Section "General-Duty Valves for HVAC Piping."

- B. Refer to Part 3 "Valve Applications" Article for applications of each valve.
- C. Calibrated Balancing Valves:
 - 1. Available Manufacturers:
 - a. NIBCO
 - b. Armstrong Pumps, Inc.
 - c. Flow Design, Inc.
 - d. Griswold Controls.
 - e. ITT Bell & Gossett; ITT Fluid Technology Corp.
 - f. Nexus Valve.
 - g. NuTech Hydronic Specialty Products
 - h. Taco, Inc.
 - 2. NPS 2 and Smaller: Bronze body, ball type, 125-psig working pressure, 250 deg F maximum operating temperature, and having threaded ends. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain set position.
 - 3. NPS 2-1/2 and Larger: Cast-iron or steel body, ball type, 125-psig working pressure, 250 deg F maximum operating temperature, and having flanged connections. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain set position.

2.7 AIR CONTROL DEVICES

- A. Available Manufacturers:
 - 1. Amtrol, Inc.
 - 2. Armstrong Pumps, Inc.
 - 3. Bell & Gossett Domestic Pump; a division of ITT Industries.
 - 4. Nexus Valve.
 - 5. NuTech Hydronic Specialty Products
 - 6. Taco.
- B. Manual Air Vents:
 - 1. Body: Bronze.
 - 2. Internal Parts: Nonferrous.
 - 3. Operator: Screwdriver or thumbscrew.
 - 4. Inlet Connection: NPS 1/2
 - 5. Discharge Connection: NPS 1/8
 - 6. CWP Rating: 150 psig
 - 7. Maximum Operating Temperature: 225 deg F
- C. Automatic Air Vent: Designed to vent automatically with float principle; bronze body and nonferrous internal parts; 150-psig working pressure; 240 deg F operating temperature; with NPS 1/4 discharge connection and NPS 1/2 inlet connection.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Heating Hot Water and Chilled Water NPS 3 and Smaller:
 - 1. Inside building and aboveground:
 - a. Type K drawn-temper copper tubing with wrought-copper fittings and soldered joints.
- B. Heating Hot Water and Chilled Water NPS 4 and Larger:
 - 1. Inside building and aboveground:
 - a. Schedule 40 steel pipe, wrought steel fittings and wrought cast or forged steel flanges and flange fittings, and welded and flanged joints.
- C. Condensate-Drain Piping: Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- D. Air-Vent Piping:
 - 1. Inlet: Same as service where installed.
 - 2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.
- E. Safety-Valve-Inlet and -Outlet Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.
- F. Miscellaneous: Same materials and joining methods as connecting service.

3.2 VALVE APPLICATIONS

- A. General-Duty Valve Applications: Unless otherwise indicated, use the following valve types:
 - 1. Shutoff Duty: Ball, and butterfly valves.
 - 2. Throttling Duty: Ball, and butterfly valves.
- B. Install shutoff duty valves at each branch connection to supply mains, unless only one piece of equipment is connected in the branch lines, and at supply connections to each piece of equipment. Install manual flow control device where indicated at branch piping.
- C. Install check valves at each pump discharge and elsewhere to control flow direction.
- D. Install safety valves on hot-water generators and as required by the ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping without valves. Comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
- E. Install pressure-reducing valves on makeup water piping to regulate system pressure.

3.3 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved in writing on Coordination Drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated at right angles or parallel to building walls, ceilings, floors and building structure. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- 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 groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and 8" NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- N. Install branch connections to mains using 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.
- O. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- P. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- Q. Install shutoff valve immediately upstream of each dielectric fitting.
- R. Install all wells, valves, taps, flow stations, etc. furnished under Section "Building Automation System."
- S. Install exterior piping at a uniform grade of 0.2 percent upward in direction of flow. Interior piping may be installed level.

- T. Install condensate drain piping at a minimum uniform slope of 1" in 10'-0" in the direction of flow.
- U. Reduce pipe sizes using concentric reducers, or eccentric reducers installed with level side up.
- V. Provide branch connections with the takeoff coming off the top of the main.
- W. Install strainers on supply side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and as indicated. Install 3/4" diameter by 8" long nipple and ball valve in blowdown connection of strainers 3/4" and larger. Match size of strainer blow-down connection for strainers smaller than 3/4".
- X. Provide seal around piping penetrations of full height interior walls, both rated and non-rated, that occur above ceilings. Refer to Section 079200 Joint Sealants.
- Y. Where piping penetrates a non-fire-resistance-rated floor or floor/ceiling assembly or ceiling membrane of a non-fire-resistance-rated roof/ceiling assembly, provide the following:
 - 1. For noncombustible piping that connects not more than five stories, protect the annular space around the piping with an approved, noncombustible material to resist the free passage of flame and the products of combustion or with a tested and classified through-penetration firestop system.
 - 2. For piping that connects not more than two stories, protect the annular space around the piping with an approved, noncombustible material to resist the free passage of flame and the products of combustion.
 - 3. For piping that penetrates a non-rated wall, protect the annular space around the penetrating piping with an approved, non-combustible materials that resists the free passage of flame and the products of combustion.

3.4 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 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.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are damaged.
3. Damaged Welds: 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.

3.5 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports." Comply with requirements below for maximum spacing of supports.
- B. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
1. 3/4": Maximum span, 7'-0"; minimum rod size, 1/4".
 2. 1": Maximum span, 7'-0"; minimum rod size, 1/4".
 3. 1 1/2": Maximum span, 9'-0"; minimum rod size, 3/8".
 4. 2": Maximum span, 10'-0"; minimum rod size, 3/8".
 5. 2 1/2": Maximum span, 11'-0"; minimum rod size, 3/8".
 6. 3": Maximum span, 12'-0"; minimum rod size, 3/8".
 7. 4": Maximum span, 14'-0"; minimum rod size, 1/2".
 8. 6": Maximum span, 17'-0"; minimum rod size, 1/2".
 9. 8": Maximum span, 19'-0"; minimum rod size, 5/8".
 10. 10": Maximum span, 20'-0"; minimum rod size, 3/4".
 11. 12": Maximum span, 23'-0"; minimum rod size, 7/8".
 12. 14": Maximum span, 25'-0"; minimum rod size, 1".
 13. 16": Maximum span, 27'-0"; minimum rod size, 1".
 14. 18": Maximum span, 28'-0"; minimum rod size, 1 1/4".
 15. 20": Maximum span, 30'-0"; minimum rod size, 1 1/4".
- C. Where hangers for steel piping are to be suspended from open-web steel joists, install hangers at maximum spacing that will result in hanger loads that comply with the requirements on the structural drawings.
- D. Install hangers for copper piping with the following maximum spacing and minimum rod sizes:
1. 3/4": Maximum span, 5'-0"; minimum rod size, 1/4".
 2. 1": Maximum span, 6'-0"; minimum rod size, 1/4".
 3. 1 1/2": Maximum span, 8'-0"; minimum rod size, 3/8".
 4. 2": Maximum span, 8'-0"; minimum rod size, 3/8".
 5. 2 1/2": Maximum span, 9'-0"; minimum rod size, 3/8".
 6. 3": Maximum span, 10'-0"; minimum rod size, 3/8".
- E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

- 3.6 Where changes in direction or tees occur, place hangers 1/3 of the maximum allowed spacing distance from the change in direction or tee (i.e. if the maximum span is 12 feet, the hanger

shall be 4 feet from the change in direction or tee). Pipe shall be supported from both sides of a change in direction.

3.7 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at coils, and elsewhere as required for system air venting.
- B. Install in-line air separators in pump suction lines. Install piping to compression tank with a 2 percent minimum upward slope toward tank.
 - 1. Install drain valve on units NPS 2 and larger.
- C. Install expansion tanks on floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system design requirements.

3.8 TERMINAL EQUIPMENT CONNECTIONS

- A. Size for supply and return piping connections shall be $\frac{3}{4}$ " or match equipment connection size or as indicated on the drawings, whichever is greater.
- B. Install control valves in accessible locations near connected equipment.
- C. Install ports for pressure and temperature gages at equipment and coil inlet and outlet connections.

3.9 CHEMICAL TREATMENT

- A. Flush system with fresh clear water until it drains clear.
- B. 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.
- C. Provide initial water treatment.

3.10 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 testing.
 - 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 system with clean water. Clean strainers.
 - 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.

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 trapped air. Use drains installed at low points for complete draining of liquid.
3. Check expansion tanks to determine that they are not air bound and that system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design pressure or a minimum of 100 psi whichever is greater. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test.
5. After hydrostatic test pressure has been applied for at least 15 minutes, 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.

3.11 ADJUSTING

- A. Mark calibrated nameplates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.

B. Perform these adjustments before operating the system:

1. Open valves to fully open position. Close coil bypass valves.
2. Check pump for proper direction of rotation.
3. Set automatic fill valves for required system pressure.
4. Check 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 and equipment are calling for full flow.
6. Check and set equipment operating temperatures to design requirements.
7. Lubricate motors and bearings.

3.12 CLEANING

- A. Remove and clean or replace strainer screens. After cleaning and flushing hydronic piping systems, but before balancing, remove disposable fine-mesh strainers.

END OF SECTION 232113

SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

- A. Product Data: For each type of valve and refrigerant piping specialty indicated for the following:
 - 1. Thermostatic expansion valves.
 - 2. Filter dryers.
 - 3. Strainers.
- B. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.3 PRODUCT STORAGE AND HANDLING

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.4 QUALITY ASSURANCE

- A. Welding/Brazing: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX; "Welding and Brazing Qualifications."
- B. ASHRAE Standard: Comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."
- C. ASME Standard: Comply with ASME B31.5, "Refrigeration Piping."
- D. UL Standard: Provide products complying with UL 207, "Refrigerant-Containing Components and Accessories, Nonelectrical"; or UL 429, "Electrically Operated Valves."

1.5 COORDINATION

- A. Coordinate layout and installation of refrigerant piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Coordinate pipe sleeve installations for wall penetrations.

- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.
- D. Coordinate pipe sleeve installations for penetrations in exterior walls and floor assemblies. Coordinate with requirements for firestopping.
- E. Coordinate pipe fitting pressure classes with products specified in related Sections.
- F. Some components listed in this section may be factory installed, such as thermostatic mixing valves or service valves.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 280, Type ACR.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Brazing Filler Metals: AWS A5.8.

2.2 VALVES AND SPECIALTIES

- A. Service Valves:
 - 1. Body: Forged brass with brass cap including key end to remove core.
 - 2. Core: Removable ball-type check valve with stainless-steel spring.
 - 3. Seat: Polytetrafluoroethylene.
 - 4. End Connections: Copper spring.
 - 5. Working Pressure Rating: 500 psig.
- B. Thermostatic Expansion Valves: Comply with ARI 750.
 - 1. Body, Bonnet, and Seal Cap: Forged brass or steel.
 - 2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
 - 3. Packing and Gaskets: Non-asbestos.
 - 4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
 - 5. Suction Temperature: 40 deg F.
 - 6. Superheat: Adjustable.
 - 7. Reverse-flow option for heat-pump applications.
 - 8. End Connections: Socket, flare, or threaded union.
 - 9. Working Pressure Rating: 450 psig.
- C. Moisture/Liquid Indicators:
 - 1. Body: Forged brass.
 - 2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
 - 3. Indicator: Color coded to show moisture content in ppm.
 - 4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.

5. End Connections: Socket or flare.
 6. Working Pressure Rating: 500 psig.
 7. Maximum Operating Temperature: 240 deg F.
- D. Permanent Filter Dryers: Comply with ARI 730.
1. Body and Cover: Painted-steel shell.
 2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
 3. Desiccant Media: Activated alumina or charcoal.
 4. Designed for reverse flow where heat-pump applications are indicated.
 5. End Connections: Socket.
 6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
 7. Maximum Pressure Loss: 2 psig Insert value.
 8. Rated Flow: Match equipment.
 9. Working Pressure Rating: 500 psig.
 10. Maximum Operating Temperature: 240 deg F.

2.3 REFRIGERANTS

- A. Available Manufacturers:
1. Atofina Chemicals, Inc.
 2. DuPont Company; Fluorochemicals Div.
 3. Honeywell, Inc.; Genetron Refrigerants.
 4. INEOS Fluor Americas LLC.
- B. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.
- C. ASHRAE 34, R-32: Difluoromethane.
- D. ASHRAE 34, R-454B: Difluoromethane/Tetrafluoropropene.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT

- A. Liquid Lines: Copper, hard drawn, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.
- B. Suction Lines for Heat-Pump Applications: Copper, hard drawn, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

- A. Install moisture/liquid indicator and filter dryer in each refrigerant circuit.

3.3 PIPING INSTALLATION

- A. 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 Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- 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 adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- L. Install refrigerant piping in protective conduit where installed belowground.
- M. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- N. Slope refrigerant piping as follows:
 - 1. Install horizontal suction lines with a uniform slope downward to compressor.
 - 2. Install traps and double risers to entrain oil in vertical runs.
 - 3. Liquid lines may be installed level.
- O. When brazing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, & packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- P. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

- Q. Identify refrigerant piping and valves according to Section "Identification for HVAC Piping and Equipment."
- R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section "Sleeves and Sleeve Seals for HVAC Piping."
- S. Install sleeve seals for piping penetrations of exterior walls and floor slabs. Comply with requirements for sleeve seals specified in Section "Sleeves and Sleeve Seals for HVAC Piping."
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section "Escutcheons for HVAC Piping."

3.4 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing.
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 - 1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
 - 2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze.

3.5 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor products are specified in Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20'-0" long.
 - 2. Roller hangers and spring hangers for individual horizontal runs 20'-0" or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20'-0" or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
 - 1. ½": Maximum span, 60"; minimum rod size, ¼".
 - 2. 5/8": Maximum span, 60"; minimum rod size, ¼".
 - 3. 1": Maximum span, 72"; minimum rod size, ¼".
 - 4. 1 ¼": Maximum span, 96"; minimum rod size, 3/8".

5. 1 ½": Maximum span, 96"; minimum rod size, 3/8".

D. Support multifloor vertical runs at least at each floor.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System shall maintain test pressure at the manifold gage throughout duration of test.
 - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
 - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.7 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
2. Break vacuum with refrigerant gas, allowing pressure to build up to manufacturer's recommendation.

3.8 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper performance.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning controllers to the system design temperature.

END OF SECTION 232300

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 PERFORMANCE REQUIREMENTS

- A. Seal all ducts to seal class A as defined in SMACNA's HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020:
 - 1. Seal all longitudinal joints.
 - 2. Seal all transverse joints.
 - 3. Seal all penetrations.
- B. Seal Class: A
- C. Test pressure:
 - 1. 3.0" WC for round and flat oval duct.
 - 2. 6.0" WC for rectangular duct.
 - 3. Un-tested: NA
- D. Test pressure and maximum leakage for smoke control ductwork:
 - 1. 1.5 times the maximum design pressure and measured leakage not to exceed 5% of design airflow.
- E. Testing: Leak test all ductwork operating at 3.0" WC or greater.
- F. Duct Construction: 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, Fourth Edition 2020" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- G. Liner Airstream Surfaces: Liner surfaces in contact with the airstream shall comply with ASHRAE 62.1-2007, paragraph 5.5.
- H. Cleanliness: All factory fabricated duct shall be cleaned with a non-toxic, biodegradable cleaner/degreaser and shall be shrink wrapped prior to shipment.
- A. Structural Performance: Smoke removal duct hangers, supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020 and ASCE/SEI 7.

1.3 ABBREVIATIONS

- A. BAS Building Automation System
- B. NRTL Nationally Recognized Testing Laboratory

- C. SMACNA Sheet Metal and Air Conditioning Contractors' National Association
- D. WC Water Column

1.4 DEFINITIONS:

- A. Duct System: For the purposes of this section "duct system" shall mean all metal supply, return, and exhaust duct and fittings between the air moving device and the space.
- B. Low Pressure: Plus two (2.0) inches WC to minus one (1.0) inches WC
- C. Medium Pressure: More than two (2.0) inches WC to plus ten (10.0) inches WC or more than minus one (1.0) inch to minus ten (10.0) inches WC
- D. High Pressure: More than plus or minus ten (10.0) inches WC.

1.5 SUBMITTALS

- A. Product Data / Documentation: For each of the following:
 - 1. Sheet metal thicknesses.
 - 2. Liners and adhesives.
 - 3. Pre-manufactured ductwork.
 - 4. Sealants and gaskets.
 - 5. VOC content for adhesives and sealants.
 - 6. Seismic-restraint devices.
- B. CAD-generated Shop Drawings:
 - 1. Provide coordination shop drawings with all trades for entire building including kitchen, laundry and water/mechanical rooms. Include
 - 2. Show fabrication and installation details for metal ducts.
 - 3. 1/4" = 1'-0" scale minimum including duct layout indicating sizes and pressure classes for the following areas:
 - a. Areas indicated on the drawings at 1/4" = 1'-0" scale.
 - b. Areas where sections are cut.
 - c. Auditoriums.
 - d. Gymnasiums.
 - e. Commercial kitchens.
 - f. Commercial laundries.
 - g. Finished spaces with exposed ductwork.
 - 1) Exceptions:
 - a) Janitors closets
 - b) Storage Rooms
 - c) Receiving Areas
 - 2) Include:
 - a) Plans, elevations and sections.
 - b) Elevations of top and bottom of ducts.
 - c) Dimensions of main duct runs from building grid lines.
 - 4. 3/4" = 1'-0" scale minimum for the following:

- a. Hangers and supports, including methods for duct and building attachment, vibration isolation and seismic restraints.
 - b. Duct accessories, including access doors and panels.
 - c. Equipment installation based on approved equipment submittals.
 - d. Penetrations through fire-rated and other partitions.
 - e. Fittings.
 - f. Components.
- C. Submittals during construction:
 - 1. Leakage Test Report: Documentation of work performed for compliance with ASHRAE/IESNA 90.1-2007, Section 6.4.4.2.2 - "Duct Leakage Tests."
 - 2. Duct-Cleaning Test Report: Documentation of work performed for compliance with ASHRAE 62.1-2007, Section 7.2.4 - "Ventilation System Start-Up."

1.6 QUALITY ASSURANCE

- A. Provide work in compliance with applicable Building Code requirements.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
- C. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
- D. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
- E. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- F. ASHRAE Compliance: Comply with applicable requirements in ASHRAE 62.1-2007, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."
- G. ASHRAE/IESNA Compliance: Comply with applicable requirements in ASHRAE/IESNA 90.1-2007, Section 6.4.4 - "HVAC System Construction and Insulation."
- H. Mockups (Contractor's option in lieu of 3"=1'-0" details):
 - 1. Before installing duct systems, build mockups. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
 - 2. Three transverse joints.
 - 3. One Reinforced section with 3 reinforcements.
 - 4. One of each type; attachments to other work.
 - 5. Two typical flexible duct or flexible-connector connections.
 - 6. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020" 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, Fourth Edition 2020," Figure 2-1, "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, Fourth Edition 2020."

- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Figure 2-2, "Rectangular Duct/Longitudinal Seams" 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, Fourth Edition 2020."
- 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, Fourth Edition 2020," Chapter 4, "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, Fourth Edition 2020."

2.2 LOW PRESSURE SINGLE-WALL ROUND DUCTS AND FITTINGS –CONCEALED

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Chapter 3, "Round, Oval, and Flexible Duct," based on specified static-pressure class unless otherwise indicated.
- B. Snap-Lock Round Pipe
 - 1. Meet SMACNA Class 3 Leakage standards and SMACNA Seal Class A with external, mastic duct sealant. Provide ASTM A653 galvanized steel, 26 gauge, G-60 coating. Product shall meet pressure rating of -1" wg to +2" wg.
 - 2. Available Manufacturers:
 - a. GreenSeam Industries (GreenSeam Plus)
- C. Manufacturers:
 - 1. Eastern Sheet Metal.
 - 2. Hamlin Sheet Metal.
 - 3. Linx Industries - Lindab.
 - 4. McGill AirFlow LLC.
 - 5. MKT Metal Manufacturing
 - 6. Semco, Inc.
 - 7. Sheet Metal Connectors, Inc.
 - 8. Spiral Manufacturing Co., Inc.
- D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Figure 3-1, "Round Duct Transverse Joints"
 - 1. Transverse Joints in Ducts Equal to or Larger Than 48" in Diameter: Flanged.
 - 2. Gasketed, EPDM, self-sealing Joints such as Eastern Tight or Spiro Safe may be used for ducts smaller than 48" in diameter.
 - 3. Flanges may be substituted in ducts smaller than 48" in diameter.
- E. Duct support intervals, and other provisions: In accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020."

- F. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Figure 3-2, "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, Fourth Edition 2020."
- G. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Figure 3-5, "90° Tees and Laterals," and Figure 3-6, "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, Fourth Edition 2020." Adjustable elbows are not permitted.
- H. All round duct shall not be less than 26-gauge.

2.3 MEDIUM PRESSURE SINGLE-WALL ROUND DUCTS AND FITTINGS –CONCEALED

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
- B. Manufacturers:
 - 1. Eastern Sheet Metal.
 - 2. Hamlin Sheet Metal.
 - 3. Linx Industries - Lindab.
 - 4. McGill AirFlow LLC.
 - 5. MKT Metal Manufacturing
 - 6. Semco, Inc.
 - 7. Sheet Metal Connectors, Inc.
 - 8. Spiral Manufacturing Co., Inc.
- C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Figure 3-1, "Round Duct Transverse Joints"
 - 1. Transverse Joints in Ducts Equal to or Larger Than 48" in Diameter: Flanged.
 - 2. Gasketed, EPDM, self-sealing Joints such as Eastern Tight or Spiro Safe may be used for ducts smaller than 48" in diameter.
 - 3. Flanges may be substituted in ducts smaller than 48" in diameter.
- D. Duct support intervals, and other provisions: In accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020."
- E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," 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, Fourth Edition 2020."
- F. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Figure 3-5, "90° Tees and Laterals," and Figure 3-6, "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, Fourth Edition 2020." Adjustable elbows are not permitted.

- G. All seam types in Figure 3-2 are acceptable where approved by SMACNA.
- H. All round duct shall not be less than 26-gauge.

2.4 LOW PRESSURE SINGLE-WALL ROUND DUCTS AND FITTINGS -EXPOSED

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Chapter 3, "Round, Oval, and Flexible Duct," "FIGURE 3-2 ROUND DUCT LONGITUDINAL SEAMS" "SPIRAL SEAM RL-1" to plus-or-minus 10" WC unless otherwise indicated.
- B. Manufacturers:
 - 1. Eastern Sheet Metal.
 - 2. Hamlin Sheet Metal.
 - 3. Linx Industries - Lindab.
 - 4. McGill AirFlow LLC.
 - 5. MKT Metal Manufacturing
 - 6. Semco, Inc.
 - 7. Sheet Metal Connectors, Inc.
 - 8. Spiral Manufacturing Co., Inc.
- C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Figure 3-1, "Round Duct Transverse Joints"
- D. Static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020." And the following:
 - 1. Transverse Joints in Ducts Equal to or Larger Than 48" in Diameter or Flat Oval with a Major Dimension Equal to or Larger Than 48": Flanged.
 - 2. Gasketed, EPDM, self-sealing Joints such as Eastern Tight or Spiro Safe may be used for ducts smaller than 48" in diameter.
 - 3. Flanges may be substituted in ducts smaller than 48" in diameter.
- E. Longitudinal Seams: Duct shall be spiral according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Figure 3-2, "Round Duct Longitudinal Seams"
- F. Tees and Laterals: Tees and laterals shall be created with fittings. Fabricate fittings according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020." Adjustable elbows are not permitted.
- G. Static-pressure class: Applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020."
- H. Longitudinal seams shall be spiral type.
- I. All round duct shall not be less than 26-gauge.

2.5 MEDIUM PRESSURE SINGLE-WALL ROUND DUCTS AND FITTINGS -EXPOSED

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Chapter 3, "Round, Oval, and Flexible Duct," "FIGURE 3-2 ROUND DUCT LONGITUDINAL SEAMS" "SPIRAL SEAM RL-1" to plus-or-minus 10" WC unless otherwise indicated.
- B. Manufacturers:
 - 1. Eastern Sheet Metal.
 - 2. Hamlin Sheet Metal.
 - 3. Linx Industries - Lindab.
 - 4. McGill AirFlow LLC.
 - 5. MKT Metal Manufacturing
 - 6. Semco, Inc.
 - 7. Sheet Metal Connectors, Inc.
 - 8. Spiral Manufacturing Co., Inc.
- C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Figure 3-1, "Round Duct Transverse Joints"
- D. Static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020." And the following:
 - 1. Transverse Joints in Ducts Equal to or Larger Than 48" in Diameter or Flat Oval with a Major Dimension Equal to or Larger Than 48": Flanged.
 - 2. Gasketed, EPDM, self-sealing Joints such as Eastern Tight or Spiro Safe may be used for ducts smaller than 48" in diameter.
 - 3. Flanges may be substituted in ducts smaller than 48" in diameter.
- E. Longitudinal Seams: Duct shall be spiral according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Figure 3-2, " Round Duct Longitudinal Seams"
- F. Tees and Laterals: Tees and laterals shall be created with fittings. Fabricate fittings according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020." Adjustable elbows are not permitted.
- G. Static-pressure class: Applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020."
- H. Longitudinal seams shall be spiral type.
- I. All round duct shall not be less than 26-gauge.

2.6 DOUBLE-WALL ROUND DUCTS AND FITTINGS (PERFORATED LINER)

- A. Manufacturers:
 - 1. Eastern Sheet Metal.
 - 2. Hamlin Sheet Metal.
 - 3. Linx Industries - Lindab.
 - 4. McGill AirFlow LLC.

5. MKT Metal Manufacturing
 6. Semco, Inc.
 7. Sheet Metal Connectors, Inc.
 8. Spiral Manufacturing Co., Inc.
- B. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.
- C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," 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, Fourth Edition 2020."
1. Transverse Joints in Ducts Equal to or Larger Than 48" in Diameter or Flat Oval with a Major Dimension Equal to or Larger Than 48": Flanged.
 2. Gasketed, EPDM, self-sealing Joints such as Eastern Tight or Spiro Safe may be used for ducts smaller than 48" in diameter.
 3. Flanges may be substituted in ducts smaller than 48" in diameter.
- D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Figure 3-2, "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, Fourth Edition 2020."
- E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Figure 3-5, "90° Tees and Laterals," and Figure 3-6, "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, Fourth Edition 2020."
- F. Inner Duct: Minimum 24-gauge perforated galvanized sheet metal steel having 3/32-inch diameter perforations with overall open area of 23 percent.
- G. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
1. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 2. Coat insulation with antimicrobial coating.
 3. Cover insulation with polyester or Mylar film complying with UL 181, Class 1.
- H. All round duct shall not be less than 26-gauge.

2.7 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020" 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.
 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M.
- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 316, cold rolled, annealed, sheet. Exposed surface finish shall be No. 4.
- E. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- F. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- G. 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.
- H. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.8 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers:
 - a. CertainTeed Corporation.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Owens Corning.
2. Maximum Thermal Conductivity:
 - 1) Type I, Flexible: 0.26 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - 2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
3. For transfer ductwork, provide antimicrobial, erosion-resistant coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
4. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

- B. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
 2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
 3. Butt transverse joints without gaps, and coat joint with adhesive.
 4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
 5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
 6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
 7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
 8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - a. Fan discharges.
 - b. Intervals of lined duct preceding unlined duct.
 - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
- D. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.9 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.
1. Materials: Certified by a NRTL.
- B. Tape sealing systems are not permitted.
- 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, 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.
 10. Indoor applications: Sealant with VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 11. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
 12. Service: Indoor or outdoor.
 13. Substrate: Compatible with galvanized sheet steel, 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.
 6. Indoor applications: Sealant with VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.10 HANGERS AND SUPPORTS

- A. Hanger Rods: Galvanized, all-thread.
- B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- D. Trapeze and Riser Supports:
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.11 RESIDENTIAL DRYER VENTING ACCESSORIES

- A. Dryer Vent Wall Box: In-wall receptacle to house dryer transition duct.
1. In-O-Vate Technologies, Inc. – Dryerbox
 2. American Aldes – Dryer vent box
 3. Lambro Industries, Inc. – Dryer wall box
 4. Construction Solutions, LLC. – Dryer vent box.
 5. Approved equal.
- B. Dryer Transition Duct: Provide UL 2158A-listed product.
1. In-O-Vate Technologies, Inc.
 2. QuietFlex Manufacturing Co, LP

3. Lambro Industries, Inc.
 4. Flexible Technologies, Inc. – Thermaflex
 5. Approved equal.
- C. Dryer Vent Long Radius Elbows:
1. In-O-Vate Technologies, Inc. – Dryer-El
 2. Approved equal for long radius elbows for dryer vent.
- D. Wall Vent: Galvanized steel body with backdraft damper. Paint or provide color per architect.
1. In-O-Vate Technologies, Inc. – Dryer Wall Vent
 2. American Aldes – Standard Dryer Wall Hood
 3. Approved equal for dryer vent terminations through exterior walls.
- E. Roof Vent: Galvanized steel body with backdraft damper.
1. In-O-Vate Technologies, Inc. – Dryer Jack
 2. American Aldes - Dryer Roof Cap
 3. Approved equal for dryer vent terminations through roofs.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. 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 by Architect in writing.
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020" unless otherwise indicated.
- C. Install ducts with fewest possible joints.
- D. Install factory-fabricated fittings for changes in direction, size, and shape and for branch connections.
- E. Unless otherwise indicated, install ducts vertically or horizontally, and parallel or perpendicular to building lines.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building. Maintain clearances for equipment maintenance.
- G. Install ducts with a clearance of 1 inch, plus allowance for installation of insulation at specified thickness.
- H. Do not route ducts through transformer vaults, electrical equipment rooms, elevator equipment rooms or electrical enclosures.
- I. 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.

- J. Provide fire dampers where ducts pass through fire-rated interior partitions, fire-rated exterior walls, fire-rated floor assemblies, or fire-rated shaft enclosures.
- K. Protect duct interiors from moisture, construction debris, dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

3.2 PROTECTION OF WALL AND FLOOR PENETRATIONS OF NON-RATED ASSEMBLIES

- A. Where ducts penetrate non-fire-resistance-rated wall or floor assemblies, protect the penetration with one of the following:
 - 1. For a duct that connects not more than two stories vertically, protect the annular space around the penetrating duct with an approved, noncombustible material that resists the free passage of flame and the products of combustion.
 - 2. For a duct that connects not more than three stories, protect the annular space around the penetrating duct with an approved, noncombustible material that resists the free passage of flame and the products of combustion and a fire damper at each floor line.
 - 3. For ducts that penetrate a smoke partition without a smoke damper, protect the annular space around the penetrating duct with an approved, non-combustible materials that resists the free passage of flame and the products of combustion.
 - 4. For ducts that penetrate a non-rated wall, protect the annular space around the penetrating duct with an approved, non-combustible materials that resists the free passage of flame and the products of combustion.

3.3 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding. Do not weld or grind lined ductwork.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of duct, fittings, hangers, supports, accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.4 DUCT SEALING

- A. Seal all ducts to seal class A as defined in SMACNA's HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020:
 - 1. Seal all longitudinal joints.
 - 2. Seal all transverse joints.
 - 3. Seal all penetrations.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Unless indicated otherwise, provide 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. Do not use powder-actuated concrete fasteners for lightweight-aggregate concrete or for slabs less than 4 inches thick.
 - 3. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and channel supports.
- E. Support vertical ducts with channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor or at a maximum interval of 18 feet.
- 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.

3.6 CONNECTIONS

- A. Make connections to equipment with flexible connectors.
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020" for branch, outlet, inlet, and terminal unit connections unless otherwise indicated.

3.7 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply two coats of flat black, latex paint over a compatible galvanized-steel primer.

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Visually inspect, for proper seal application, all ductwork not tested prior to insulation application. Prepare inspection report.
- C. Smoke Control Duct Air Leakage Test – Test all smoke control ductwork.
 - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Prepare a report for each test.
 - 2. Test ducts. Disassemble, reassemble, reseal, and retest until 5% leakage of design airflow or less is achieved.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 4. Test for leaks before applying external insulation.
 5. Conduct tests at static pressures 1.5 times the maximum design pressure of system or section being tested.
 6. Provide seven-day advanced notice to Architect and Owner for leakage testing.
- D. Leakage Test. Test ducts with operational pressures greater than 3" WC.
1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Prepare a report for each test.
 2. Test ducts, disassemble, reassemble, reseal, and retest until leakage class 3 (as defined in SMACNA's HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020) is achieved.
 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 4. Test for leaks before applying external insulation.
 5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested.
 6. Give seven days' advance notice to Architect and Owner for testing.
- E. Duct System Cleanliness Tests:
1. Visually inspect duct system to ensure that no visible contaminants are present. If visible contaminants are present, proceed to sub-paragraph 2 below. If not, no further cleaning shall be required.
 2. Test sections of metal duct systems, up to one location per ten thousand (10,000) square feet of building area, or a minimum of two (2) per system, whichever is greater, chosen by the Owner's Representative, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems." Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm. Cut hole in duct and install access door at each location selected. Size shall be as indicated in Division 23 Section "Air Duct Accessories."
 3. Duct system shall be considered dirty and in need of cleaning if any test location does not pass the cleanliness test. Cleaning shall be performed in accordance with this specification.
- F. Prepare and submit test and inspection reports.

3.9 DUCT CLEANING

- A. Clean new duct systems before testing, adjusting, and balancing.
- B. Comply with SMACNA "Duct Cleanliness for New Construction Guidelines" dated 2000, for protection, cleaning, and installation methods for all ductwork. Adhere to the requirements for a duct cleanliness level of "C" (advanced level) as detailed in Section 3.11.

3.10 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
- B. Ducts Connected to Dishwasher Hoods:
 - 1. Type 304, stainless-steel sheet.
 - 2. Exposed to View: No. 4 finish.
 - 3. Concealed: No. 2D finish.
 - 4. Welded seams and flanged joints with watertight EPDM gaskets.
 - 5. Negative – match or exceed fan static pressure.
 - 6. Seal: Welded seams, joints, and penetrations.
 - 7. SMACNA Leakage Class: 3.
- C. Ducts Connected Serving Shower Rooms:
 - 1. Aluminum sheet.
 - 2. Exposed to View: Bright finish.
 - 3. Concealed: Mill finish.
- D. Double-Wall Duct Interstitial Insulation (where indicated):
 - 1. Supply Air Ducts: 1" thickness.
- E. Transfer Duct Liner (where indicated): 1" thickness.
- F. Elbow Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Figure 4-2, "Rectangular Elbows."
 - a. Velocity less than 1500 fpm or lower:
 - 1) Radius Type RE 1. Centerline radius = $3W/2$.
 - 2) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 - 3) Transfer ducts indicated with mitered elbows do not require turning vanes.
 - b. Velocity 1500 fpm or Higher:
 - 1) Radius Type RE 3. Centerline radius = $3w/2$ and three vanes.
 - 2) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," 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, Fourth Edition 2020," Figure 3-4, "Round Duct Elbows."
 - a. Minimum centerline radius-to-diameter ratio shall be 1.5 with a maximum of 5 Elbow Segments. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Table 3-1, "Mitered Elbows." Elbows with less than a 90 degree change of direction shall have segments per Table 3-1 in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020".

- b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped, segmented, spiral or pleated. Adjustable elbows not acceptable.
- c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam, segmented, or spiral.
- 3. Flat Oval Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Figure 3-7, "Flat Oval Ducts" for elbows.

G. Branch Configuration:

- 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Figure 4-6, "Branch Connections."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Conical or bell mouth. No flanged or spin-in fittings permitted.
- 2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Figure 3-6, "Conical Tees."
 - a. Conical fitting.
 - b. Conical saddle taps.
 - c. No 90 degree taps or 90 degree saddle taps permitted.

H. Divided Flow Branches:

- 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Figure 4-5 Divided Flow Branches."

3.12 Duct Pressure Classes:

- A. Supply ducts from air handling units to terminal units: 3 inches WC.
- B. Supply ducts from air handling units to air terminals: 2 inches WC.
- C. Supply ducts from terminal units to air terminals: 1 inch WC.
- D. Return ducts: -1 inch WC.
- E. Exhaust ducts: -2 inch WC.
- F. Smoke exhaust ducts: -4 inch WC.

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

- A. Product Data: For the following:
 - 1. Radius forming braces
 - 2. Volume dampers.
 - 3. Smoke control manual volume dampers.
 - 4. Smoke control dampers
 - 5. Fire dampers.
 - 6. Smoke dampers.
 - 7. Combination fire-smoke dampers.
 - 8. Flange connectors.
 - 9. Turning vanes.
 - 10. Remote damper operators.
 - 11. Duct-mounted access doors.
 - 12. Duct access panel assemblies.
 - 13. Flexible connectors.
 - 14. Flexible ducts.
 - 15. Duct security bars.
- B. Wiring Diagrams: For power, signal, and control wiring.
- C. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.3 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.
- C. Comply with SMACNA standards for manual airflow regulators (dampers).

1.4 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. Minimum 1 of each type used.

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. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable duct installation methods unless otherwise indicated.
- C. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a NO 2 finish for concealed ducts and NO 4 finish for exposed ducts.
- E. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- F. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- G. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- H. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches; compatible materials for aluminum and stainless-steel ducts.

2.2 RADIUS FORMING BRACES

- A. Available manufacturers:
 - 1. Titus, FlexRight (Basis of Design)
 - 2. Flexible Technologies, Inc., Thermaflex Division, FlexFlow
 - 3. Hart & Cooley, Smart Flow Elbow
- B. General: UL-2043 listed or NRTL approved product constructed of metal or plastic manufactured for use with flexible duct to form a kink free elbow using the flexible duct. Any flexible duct used in forming the elbow shall be included in the maximum permitted length. Resulting flexible duct shall comply with SMACNA HVAC Duct Construction Standards.
- C. Duct Size: 6" through 16" in diameter.
- D. Inside (Bend) Radius: Minimum of one duct diameter along centerline.
- E. Attachments: Plastic zip ties or stainless steel worm gear clamps.
- F. Support to Overhead: Shall meet SMACNA requirements. Use of specified attachments for support shall not be permitted.

2.3 MANUAL VOLUME DAMPERS

- A. Steel, Manual Volume Dampers:

1. Manufacturers:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Elgen Manufacturing.
 - d. Greenheck Fan Corporation.
 - e. McGill AirFlow LLC.
 - f. Nailor Industries.
 - g. PCI Industries - Pottorff
 - h. Ruskin Company.
 2. Standard leakage rating, with linkage outside airstream.
 3. Suitable for horizontal or vertical applications.
 4. Frames:
 - a. Hat-shaped, 0.094-inch thick galvanized or 0.05-inch stainless-steel, match duct material.
 - 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. Opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized or stainless-steel channels, match duct material.
 6. Blade Axles: Galvanized steel or stainless steel. Dampers over 12" width/diameter shall include continuous axles. Dampers 12" and less may have non-continuous axles. Comply with SMACNA HVAC Duct Construction Standards Metal and Flexible – Third Edition Figure 7-4.
 7. Bearings:
 - a. Molded synthetic. Provide bearing at both duct wall penetrations.
 8. Tie Bars and Brackets: Galvanized steel.
- B. Aluminum, Manual Volume Dampers:
1. Manufacturers:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Elgen Manufacturing.
 - d. Greenheck Fan Corporation.
 - e. McGill AirFlow LLC.
 - f. Nailor Industries.
 - g. PCI Industries - Pottorff
 - h. Ruskin Company.

2. Standard leakage rating, with linkage and operator outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames: Hat-shaped aluminum channels for installing in ducts.
5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Roll Formed or Extruded Aluminum.
 - e. Blade Axles: Galvanized steel or Stainless steel. Dampers over 12" width/diameter shall include continuous axles. Dampers 12" and less may have non-continuous axles. Comply with SMACNA HVAC Duct Construction Standards Metal and Flexible – Third Edition Figure 7-4.
6. Bearings:
 - a. Molded synthetic. Provide bearing at both duct wall penetrations.
7. Tie Bars and Brackets: Aluminum.

C. Damper Hardware:

1. Zinc-plated, die-cast manual quadrant kit with dial and handle made of zinc plated steel, and a hexagon lock nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform or stand-off for insulated duct mounting.

2.4 SMOKE CONTROL MANUAL VOLUME DAMPERS

A. Steel, Manual Volume Dampers:

1. Manufacturers:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Flexmaster U.S.A., Inc.
 - d. Greenheck Fan Corporation.
 - e. McGill AirFlow LLC.
 - f. METALAIRE, Inc.
 - g. Ruskin Company.
 - h. Vent Products Company, Inc.
2. Low leakage rating, with linkage outside airstream, leakage rating of 3 cfm/sf @ 1" wg or less.
3. Suitable for air velocities up to 4000 fpm and pressures up to 10" wg differential.
4. Suitable for horizontal or vertical applications.
5. Temperature Rating: 250°F.
6. Frames:
 - a. Hat-shaped, galvanized or stainless-steel channels, match duct material.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
7. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.

- c. Stiffen damper blades for stability.
 - d. Galvanized or stainless-steel channels, match duct material.
 - e. Blade Axles: Galvanized steel or Stainless steel.
- 8. Bearings:
 - a. Bronze or 304SS.
 - b. Dampers shall have axles full length of damper blades and bearings at both ends of operating shaft.
- 9. Tie Bars and Brackets: Galvanized steel.
- B. Damper Hardware:
 - 1. Zinc-plated, die-cast quadrant with dial and handle made of zinc plated steel, and a hexagon lock nut and locking washer.
 - 2. Include center hole to suit damper operating-rod size.
 - 3. Include elevated platform for insulated duct mounting.

2.5 SMOKE CONTROL DAMPERS

- A. Manufacturers:
 - 1. Cesco Products; a division of Mestek, Inc.
 - 2. Greenheck Fan Corporation. (Basis of design, provide model SMD-301)
 - 3. Johnson Controls
 - 4. Nailor Industries, Inc.
 - 5. PCI Industries - Pottorff
 - 6. Ruskin Company.
- B. Type: Dynamic; rated and labeled according to UL 555S by a NRTL.
- C. Closing rating in ducts up to 4-inch WC static pressure class and minimum 3000 FPM velocity.
- D. General Requirements: Label according to UL 555S by a NRTL.
- E. Configuration: Multiple-blade type; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- F. Blades: Roll-formed, horizontal, interlocking, 0.07 inch thick, galvanized sheet steel air foil.
- G. Blade edge seals: Silicone rubber.
- H. Blade linkage: Out of air stream.
- I. Leakage: Class I.
- J. Mounting Sleeve: Factory-installed galvanized sheet steel; length to suit wall or floor application.
- K. Damper Motor: Two-position.
- L. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size shall be large enough so driven load will not require motor to operate in service factor.

2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section "Building Automation System" and Division 28 Sections.
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 IN x LBF and breakaway torque rating of 150 IN x LBF.
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at 0 degrees F.

M. Accessories:

1. Auxiliary switches for position indication.
2. Damper mounted momentary test switch.

2.6 CURTAIN TYPE FIRE DAMPERS (1½ HOUR)

A. Manufacturers:

1. Cesco Products; a division of Mestek, Inc.
2. Greenheck Fan Corporation.
3. Johnson Controls, Inc.
4. Nailor Industries, Inc.
5. PCI Industries - Pottorff
6. Ruskin Company.

B. Type: Dynamic; rated and labeled according to UL 555 by a NRTL.

C. Pressure: Dampers shall have a minimum UL 555 differential pressure rating of 4 in. WG

D. Velocity: Dampers shall have a minimum UL 555 velocity rating of 2000 FPM.

E. Fire Rating: 1½ hours.

F. Frame: Curtain type with blades outside the airstream unless otherwise indicated; fabricated of roll-formed galvanized steel; with mitered and interlocking corners.

G. Sleeve: Factory-installed, galvanized sheet steel.

1. Minimum Thickness: Per UL requirements.
2. Minimum Length: To suit application.

H. Option for security bars: When the fire damper is to be installed in the same wall as a security bar provide the fire damper with a manufacturer installed option to include a security bar.

I. Mounting Orientation: Vertical or horizontal as indicated.

J. Blades: Roll-formed, interlocking galvanized sheet steel. In place of interlocking blades, full-length galvanized-steel blade connectors may be used.

K. Horizontal Dampers: Include stainless-steel closure spring.

L. Fusible Link: Replaceable, 165 deg F rated.

- M. Retaining Angles: Damper shall be supplied with factory retaining angles sized to provide installation overlap in accordance with the manufacturer's UL listing

2.7 MULTI BLADE FIRE DAMPERS (1½ HOURS)

- A. Manufacturers:
 - 1. Cesco Products; a division of Mestek, Inc.
 - 2. Greenheck Fan Corporation.
 - 3. Johnson Controls, Inc.
 - 4. Nailor Industries, Inc.
 - 5. PCI Industries - Pottorff
 - 6. Ruskin Company.
- B. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.
- C. Pressure: Dampers shall have a minimum UL 555 differential pressure rating of 4 in. WG
- D. Velocity: Dampers shall have a minimum UL 555 velocity rating of 4000 FPM.
- E. Fire Rating: 1½ hours.
- F. Frame: Multiple-blade type; fabricated of galvanized steel; with mitered and interlocking corners.
- G. Sleeve: Factory-installed, galvanized sheet steel.
 - 1. Minimum Thickness: Per UL requirements.
 - 2. Minimum Length: To suit application.
- H. Mounting Orientation: Vertical or horizontal.
- I. Blades: Blades: Damper blades shall be galvanized steel. Each blade shall be symmetrical relative to its axle pivot point, presenting identical performance characteristics with air flowing in either direction. Provide symmetrical blades of varying size as required to completely fill the damper opening.
- J. Blade Stops: Locate blade stops at top and bottom of damper frame. They shall occupy no more than ½" of the damper opening area.
- K. Bearings: Axle bearings shall be sintered bronze.
- L. Horizontal Dampers: Include stainless-steel closure spring.
- M. Fusible Link: Replaceable, 165 deg F rated.
- N. Retaining Angles: Damper shall be supplied with factory retaining angles sized to provide installation overlap in accordance with the manufacturer's UL listing.

2.8 SMOKE DAMPERS

- A. Manufacturers:
 - 1. Cesco Products; a division of Mestek, Inc.
 - 2. Greenheck Fan Corporation. (Basis of design, provide model SMD-301)
 - 3. Johnson Controls, Inc.
 - 4. Nailor Industries, Inc.

- 5. PCI Industries - Pottorff
- 6. Ruskin Company.
- B. General Requirements: Rated and labeled according to UL 555S by an NRTL.
- C. Closing rating in ducts up to 4-inch WC static pressure class and minimum 3000 FPM velocity.
- D. Configuration: Multiple-blade type; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- E. Blades: Roll-formed, horizontal, interlocking, 0.07 inch thick, galvanized sheet steel air foil.
- F. Blade edge seals: Silicone rubber.
- G. Blade linkage: Out of air stream.
- H. Leakage: Class II.
- I. Mounting Sleeve: Factory-installed galvanized sheet steel; length to suit wall or floor application.
- J. Damper Motor: Two-position.
- K. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size shall be large enough so driven load will not require motor to operate in service factor.
 - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section "Building Automation System" and Division 28 Sections.
 - 3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 - 4. Spring-Return Motors: Equip with an integral spiral-spring mechanism. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 IN x LBF and breakaway torque rating of 150 IN x LBF.
 - 5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at 0 degrees F.
- L. Accessories:
 - 1. Auxiliary switches for position indication.
 - 2. Damper mounted momentary test switch.

2.9 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers:
 - 1. Cesco Products; a division of Mestek, Inc.
 - 2. Greenheck Fan Corporation. (Basis of design, provide model FSD-331)
 - 3. Johnson Controls, Inc.
 - 4. Nailor Industries, Inc.
 - 5. PCI Industries - Pottorff
 - 6. Ruskin Company.
- B. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by a NRTL.

- C. Closing rating in ducts up to 4-inch WC static pressure class and minimum 2000 FPM velocity.
- D. Fire Rating: 3 hours or as indicated.
- E. Configuration: Multiple-blade type; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- F. Heat-Responsive Device: Electric resettable link and switch package, factory installed and rated. Provide damper position indicator to indicate open & closed positions.
- G. Frame: Multiple-blade type; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- H. Bearings: Sintered bronze.
- I. Blades: Roll-formed, horizontal, interlocking, 0.07 inch thick, galvanized sheet steel air foil.
- J. Blade edge seals: Silicone rubber.
- K. Blade linkage: Out of air stream.
- L. Leakage: Class II.
- M. Mounting Sleeve: Factory installed galvanized sheet steel; length to suit wall or floor.
- N. Damper Motors: Two-position.
- O. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size shall be large enough so driven load will not require motor to operate in service factor.
 - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section "Building Automation System" and Division 28 Sections.
 - 3. Spring-Return Motors: Equip with an integral spiral-spring mechanism. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 IN x LBF and breakaway torque rating of 150 IN x LBF.
 - 4. Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Provide motors with internal heaters to permit normal operation at 0 degrees F.
- P. Accessories:
 - 1. Auxiliary switches for position indication.
 - 2. Damper mounted momentary test switch.

2.10 FLANGE CONNECTORS

- A. Available Manufacturers:
 - 1. Ductmate Industries, Inc.
 - 2. Nexus PDQ; Division of Shilco Holdings Inc.
 - 3. Hart & Cooley, Inc.
- B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

- C. Material: Match connecting ductwork.
- D. Gauge: 18, 20, or 24 as recommended by manufacturer or match connecting ductwork.

2.11 MANUFACTURED TURNING VANES

- A. Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- B. 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."
- C. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.12 REMOTE DAMPER OPERATORS

- A. Manufacturers:
 - 1. Metropolitan Air Technology.
 - 2. PCI Industries – Pottorff.
 - 3. Ruskin Company.
 - 4. Ventfabrics, Inc.
 - 5. Young Regulator Company.
- B. Description: Cable system designed for remote manual damper adjustment.
- C. Tubing: Brass.
- D. Cable: Stainless steel.
- E. Operator Mounting Location: As indicated. If not indicated;
 - 1. In airstream terminating at face of diffuser.
 - 2. Outside airstream terminating at round ceiling cup.
 - 3. If multiple diffusers are affected, then in nearest diffuser.

2.13 DUCT-MOUNTED ACCESS DOORS

- A. Available Manufacturers:
 - 1. Ductmate Industries, Inc.
 - 2. Flexmaster U.S.A., Inc.
 - 3. Greenheck Fan Corporation.
 - 4. Kees
 - 5. McGill AirFlow LLC.
- B. 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. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.

- d. 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 Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
 - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.14 FLEXIBLE CONNECTORS

- A. Do not use on smoke control/management fans. Install on all other fans and fan equipped units even when provided with internal isolation.
- B. Available Manufacturers:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Corporation.
 - 3. Ventfabrics, Inc.
 - 4. Hart & Cooley, Inc.
- C. Materials: Flame-retardant or noncombustible fabrics.
- D. Coatings and Adhesives: Comply with UL 181, Class 1.
- E. Connector: Factory fabricated with a fabric strip 3½ to 4½ inches wide attached to 2 strips of 2½ to 4½ inches wide, 23 to 25 gauge “0.0269 to .0209 inch thick” galvanized sheet steel, stainless sheet steel, or aluminum sheets. Provide metal compatible with connected ducts.
- F. Indoor System, Flexible Connector Fabric: Glass fabric double-coated with neoprene.
 - 1. Minimum Weight: 26 oz/sq. yd.
 - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - 3. Service Temperature: Minus 40 to plus 200 deg F.
- G. Outdoor System, Flexible Connector Fabric: Glass fabric double-coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 - 1. Minimum Weight: 24 oz/sq. yd.
 - 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
 - 3. Service Temperature: Minus 50 to plus 250 deg F.
- H. Thrust Limiters:
 - 1. Field fabricated cable restraints on equipment producing greater than 4.0” WC of positive pressure.
 - 2. Field fabricated cable restraints as detailed. If not detailed; Provide restraint consisting of a 1/16 inch diameter vinyl coated steel cable at 24” maximum on center, attached to flange bolts on each side of flexible connector. Cable length shall be such that, when in tension, ½” of movement in the flexible connection is preserved. If flanges are not used, contractor may provide steel, stainless steel, or aluminum angles for attaching cables. Match duct material. Cables shall attach to screw or fastener holding angle to duct and shall be routed through a 3/16” diameter hole in the bracket offset approximately 1” from duct.
 - 3. Direction of connector movement: Parallel with airflow, perpendicular to connector.

2.15 FLEXIBLE AIR DUCTS

- A. Manufacturers:
 - 1. Flexmaster U.S.A., Inc. (Basis of design, Provide Type 1M)
 - 2. Thermaflex
 - 3. Hart & Cooley, Inc.
- B. Provide bead on connecting duct for sizes greater than 12" in diameter.
- C. Maximum Length: 6'-0" unless noted otherwise.
- D. Insulated, Flexible Duct: UL 181, Class 1 air duct with vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
 - 1. Pressure Rating: 10-inch WC positive and 1.0-inch WC negative.
 - 2. Maximum Air Velocity: 5000 fpm.
 - 3. Vapor Barrier Permeance: 0.05 perm
 - 4. Temperature Range: Minus 10 to plus 160 deg F.
 - 5. Insulation R-value: 6.0
- E. Flexible Duct Connection Accessories:
 - 1. Low pressure (Not up stream of terminal units):
 - a. Clamps: Nylon strap in sizes 3 through 20", to suit duct size.
 - b. Sheet metal screws: No
 - c. Liquid adhesive: No
 - d. Tape: Yes
 - 2. Medium pressure (Up stream of terminal units):
 - a. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with worm-gear action in sizes 3 through 20 inches, to suit duct size.
 - b. Sheet metal screws: No
 - c. Liquid adhesive: Yes
 - d. Tape: Yes

2.16 DUCT SECURITY BARS

- A. Manufacturers:
 - 1. Keys
 - 2. Price Industries.
 - 3. United Sheet Metal
 - 4. Field or Shop-Fabricated
- B. Description: Factory, shop or field-fabricated and field-installed duct security bars rated for "Maximum Security".
- C. Configuration:
 - 1. Frame: 2 1/4" by 3/8" inches minimum steel bar.
 - 2. Sleeve: 3/16-inch, continuously welded steel frames with 2 1/4"x2 1/4"x3/8" angle frame factory welded to 1 end and furnished loose for field welding on other end. To be welded or bolted in place, one side only. Duct connections as indicated.

3. Horizontal Bars: 2¼" by 3/8" minimum tool resistant steel conforming to ASTM A627-95.
4. Horizontal Bar spacing: 12" OC maximum.
5. Vertical Bars: 7/8" diameter minimum, ribbed on opposite sides, tool resistant steel conforming to ASTM A627-95.
6. Vertical Bar Spacing: 5" OC maximum.
7. Where duct security bars are to be installed within the same penetration/ opening as a life safety damper, provide the security bars in the life safety damper sleeve. The damper with security bars shall be a UL listed assembly. Life Safety dampers include fire dampers, smoke dampers, and fire-smoke dampers.
8. Where duct security bars are to be installed in roof penetrations/ openings, the security bars shall be coordinated and integrated with the roof curbs.

2.17 ACCESSORY HARDWARE

- A. Temporary Test Holes: Drilled in duct as required.
- B. Permanent Test Holes: Cast iron, or cast aluminum, to suit adjacent material, including cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit wall + insulation thickness.
- C. Adhesives: High strength, quick setting, waterproof, and resistant to 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."
- 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. Radius Forming Braces:
 1. Connect flexible ducts to diffusers using a radius forming brace or rigid elbow. If using radius forming brace, deduct four duct diameters from the indicated maximum flexible duct length.
- D. Volume Dampers:
 1. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Locate at least two duct diameters from fittings and as far as possible from air outlets.
 2. 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.
 3. Set dampers to fully open position before testing, adjusting, and balancing.
 - a. Install steel volume dampers in steel ducts.
 - b. Install aluminum volume dampers in aluminum and stainless steel ducts.
- E. Install backdraft dampers at inlet of exhaust fans, exhaust ducts as close as possible to louver inlets, and where indicated.

- F. Install fire and smoke dampers where indicated according to UL listing and manufacturer's written instructions.
- G. Connect ducts to duct silencers with flexible duct connectors.
- H. Turning Vanes:
 - 1. Install turning vanes in all duct elbows larger than 12" in height or width.
 - 2. Exceptions:
 - a. Where prohibited by the applicable code, laws, ordinances or local requirements.
 - b. Where specifically eliminated by Contract.
- I. Provide remote damper operator where manual volume dampers are indicated above inaccessible ceilings.
- J. Duct-Mounted Access Doors:
 - 1. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - a. On both sides of duct coils.
 - b. Upstream or downstream of duct filters.
 - c. At outdoor air intakes and mixed air plenums.
 - d. Downstream of control dampers and backdraft dampers.
 - e. Adjacent to fire or smoke dampers to allow reset and reinstallation of fusible links. Access doors for fire or smoke dampers having fusible links shall be pressure relief access doors and shall have outward operation for access doors installed upstream of dampers and inward operation for access doors installed downstream of dampers.
 - f. Upstream or downstream of duct silencers.
 - g. At control devices requiring inspection.
 - h. Elsewhere as indicated.
 - 2. Install access doors with swing against duct static pressure except at fire, smoke, and combination fire and smoke dampers.
 - 3. Access Door Size: Largest of the following permitted by duct dimensions:
 - a. One-Hand or Inspection Access: 8 by 5 inches.
 - b. Two-Hand Access: 12 by 6 inches.
 - c. Head and Hand Access: 18 by 10 inches.
 - d. Head and Shoulders Access: 21 by 14 inches.
 - e. Body Access: 25 by 14 inches.
 - f. Body plus Ladder Access: 25 by 17 inches.
 - 4. Label access doors to indicate purpose in accordance with Section 230553 "Identification for HVAC Piping and Equipment."
- K. Flexible Connectors
 - 1. Install flexible connectors to connect ducts to equipment- except smoke control/management equipment.
 - 2. For fans developing static pressures of 4" WC and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
 - 3. Where required, install thrust limiters at all flexible connectors consisting of a 1/16-inch diameter vinyl coated steel cable at 24" maximum on center, attached to flange bolts on each side of flexible connector. Cable length shall be such that, when in tension, 1/2" of

movement in the flexible connection is preserved. If flanges are not used, provide steel, stainless steel, or aluminum angles for attaching cables. Match angle material to duct material. Cables shall attach to screw or fastener holding angle and shall be routed through a 3/16" diameter hole in the angle offset approximately 1" from duct.

L. Connect flexible ducts to metal ducts as follows:

1. Low pressure (Not upstream of terminal units):
 - a. Clamps: Install in accordance with manufacturer's recommendations.
 - b. Tape: Install in accordance with manufacturer's recommendations.
 - c. Cable Ties (18 lb. strength): Install in accordance with manufacturer's recommendations.

M. Flexible Ducts

1. Install flexible duct fully extended with no more than 1/2" compression or sag. Do not provide excess length for future relocation of components. Bends shall equal or exceed one duct diameter bend radius based on the inside duct diameter (no sharp corners or kinks). Tape and mastic for sealing flexible duct to metal fittings shall be listed and labeled to UL Standard 181B. Hanging straps, if used, shall include a saddle to avoid crimping the duct. For ducts 12 inches and smaller in diameter, provide a 3" wide saddle. For ducts larger than 12 inches in diameter, provide a 5" wide saddle.
2. Connect supply ceiling diffusers and return grilles to low pressure supply and/or return ductwork where indicated on drawings with five feet maximum length of flexible duct. Provide a radius forming elbow to support flexible duct at diffuser connection unless noted otherwise. Flexible duct not permitted on exhaust systems.

N. Install duct security bars where indicated. Construct duct security bars from 0.164-inch steel sleeve, continuously welded at all joints and 1/2-inch diameter steel bars, 6 inches on center in each direction in center of sleeve. Weld each bar to steel sleeve and each crossing bar. Weld 2-1/2 x 2-1/2 x 1/4-inch steel angle to four sides and both ends of sleeve. Connect duct security bars to ducts with flexible connections. Provide 12-inch x 12-inch hinged access panel with cam lock in duct in each side of sleeve.

O. Install rooftop duct supports for all roof-mounted ductwork.

3.2 TESTING AND BALANCING

- A. Install permanent test holes at fan inlets and outlets within 6 inches of fan, where indicated, and where necessary for testing and balancing. Test holes not required at outlet of roof-mounted fans.
- B. Install temporary test hole plugs in temporary test holes. Repair insulation at temporary test holes.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement without interference.
2. Inspect access doors. Verify that door can be opened and closed. Verify fire damper, and combination fire and smoke damper fusible links can be reset and changed. Verify fire damper, and combination fire and smoke damper doors open in the direction of air pressure (out on supply ducts and in on return and exhaust ducts).

3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement, verify non-interference, and verify that the proper heat-response device is installed.
4. Inspect elbows for turning vanes. Verify they are installed where required.
5. Inspect turning vanes using access doors for proper and secure installation.
6. Operate remote damper operators prior to ceiling installation to verify full range of movement of operator and damper. Verify no interference with damper movement.

END OF SECTION 233300

SECTION 233423 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

- A. Product Data: Provide manufacturer's technical data for each ventilator including rated capacities, dimensions, required clearances, operating characteristics, mounting requirements, and furnished specialties and accessories. Provide power and control wiring diagrams. Also include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 4. Material thickness and finishes, including color charts.
 - 5. Dampers, including housings, linkages, and operators.
 - 6. Roof curbs with required slope and dimensions. Indicate shimming if required.
 - 7. Security fasteners.
 - 8. Fan speed controllers.
- B. Operation and Maintenance Data: For ventilators to include in emergency, operation, and maintenance manuals.

1.3 TOOLS

- A. Four (4) complete tools (all hardware) required to remove and reinstall security fasteners.
- B. Specifications, including size, of tool required to remove and reinstall security fasteners.
- C. The name and address of three local tool suppliers where tools may be obtained.

1.4 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. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.
- C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for grease (kitchen) hood exhaust shall also comply with UL 762.

1.5 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.6 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. Belts: One set for each belt-driven fan. Mark belt set with fan ID and turn over to owner's representative.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATOR(S) (DOWNBLAST)

- A. Manufacturers:
 - 1. Acme Engineering & Manufacturing Corporation.
 - 2. Twin City Fan & Blower.
 - 3. Greenheck Fan Corporation.
 - 4. Loren Cook Company.
- B. Housing: Removable, spun-aluminum dome top and outlet baffle, or extruded-aluminum, rectangular top to direct discharge air downward.
- C. Base (Curb Cap): Square, one-piece, aluminum with venturi inlet cone.
- D. Hinged Sub-Base: Galvanized steel hinged arrangement permitting service and maintenance.
- E. Fan Wheels: Statically and dynamically balanced aluminum hub and wheel with backward-inclined blades matched to inlet cone.
- F. Belt Drives (where indicated in Fan Schedule): Comply with the following:
 - 1. Provide drives sized for a minimum of 150% of driven horsepower.
 - 2. Provide resilient mounting to housing.
 - 3. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 - 4. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 - 5. Pulleys: Cast-iron, adjustable-pitch motor pulley.
 - 6. Fan and motor isolated from exhaust airstream
 - 7. Belt(s): Provide grip notch belt(s). Provide belt tensioner.
 - 8. Motors and drives:
 - a. Mount on vibration isolators.

- b. Draw air for motor cooling into the motor compartment from an area free of discharge contaminants.
 - c. Make readily accessible for maintenance.
 - G. Overload (Running) Protection:
 - 1. Provide motor overload protection as a requirement of this section.
 - 2. Provide motor overload protection as recommended by the manufacturer
 - 3. Comply with the Section 230513 "Motors for HVAC Equipment"
 - H. Wind-band: Join to curb-cap with leak-proof continuously welded seam.
 - I. Accessories:
 - 1. Provide disconnect switch.
 - 2. Provide removable, 1/2-inch mesh, aluminum or brass wire bird screen.
 - 3. Provide parallel-blade dampers mounted in fan base or duct with normally closed electric actuator wired to close when fan stops. Actuator shall not be required to fail closed.
 - 4. Provide roof curb. Refer to Roof Curb Paragraph below.
 - 5. Security Bars: Comply with Division 23 Section, 233300 "Air Duct Accessories"
- 2.2 CENTRIFUGAL DISHWASHER ROOF VENTILATOR(S) (UPBLAST)
- A. Manufacturers:
 - 1. Acme Engineering & Manufacturing Corporation.
 - 2. Twin City Fan & Blower.
 - 3. Greenheck Fan Corporation.
 - 4. Loren Cook Company.
 - B. Housing: Removable, spun-aluminum, dome top and outlet baffle or extruded-aluminum, rectangular top; square, one-piece, aluminum base with venturi inlet cone.
 - 1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.
 - C. Base (Curb Cap): Square, one-piece, aluminum with venturi inlet cone welded solid to Base.
 - 1. Hinged Subbase: Factory installed galvanized-steel hinged arrangement permitting service and maintenance. Include restraints to hold fan above roof and to prevent fan from hitting curb, or curb cant, when opened.
 - 2. Provide flexible electrical cable, with slack required, inside housing to permit use of hinged subbase for inspection and cleaning
 - D. Fan Wheels: Aluminum hub and wheel statically and dynamically balanced with backward-inclined blades matched to inlet cone and with a non-stick or Teflon coating.
 - E. Belt Drives (where indicated in Fan Schedule): Comply with the following:
 - 1. Provide drives sized for a minimum of 150% of driven horsepower.
 - 2. Provide resilient mounting to housing.
 - 3. Belt(s):

- a. Provide grip notch belt(s).
 - b. Provide belt tensioner.
- 4. Provide cast iron, adjustable pitch pulleys keyed to shaft.
- 5. Provide motor isolated from ducted airstream.
- 6. Shaft Bearings:
 - a. Provide permanently lubricated pillow block type.
 - b. Provide sealed bearings.
 - c. Provide self-aligning type.
 - d. Provide ball bearings selected for a minimum (L10) life in excess of 100,000 hours at maximum cataloged operating speed.
- 7. Fan Shaft:
 - a. Provide turned, ground, and polished steel shaft.
 - b. Key shaft to fan wheel.

F. Overload (Running) Protection:

- 1. Provide motor overload protection as a requirement of this section.
- 2. Provide motor overload protection as recommended by the manufacturer
- 3. Comply with the Section 230513 "Motors for HVAC Equipment"

G. Accessories:

- 1. Provide disconnect switch.
- 2. Provide removable, 1/2-inch mesh, aluminum or brass wire bird screen.
- 3. Provide parallel-blade dampers mounted in fan base or duct with normally closed electric actuator wired to close when fan stops. Actuator shall not be required to fail closed.
- 4. Dishwasher Fan Curb: Terminate exhaust duct a minimum of 24" above finished roof surface. Provide required curb height.
- 5. Security Bars: Comply with Division 23 Section, 233300 "Air Duct Accessories"

2.3 CENTRIFUGAL ROOF VENTILATOR(S) (TUBE AXIAL UPBLAST, SMOKE CONTROL)

A. Manufacturers:

- 1. Acme Engineering & Manufacturing Corporation.
- 2. Twin City Fan & Blower.
- 3. Greenheck Fan Corporation.
- 4. Loren Cook Company.

B. Listings: UL listing for "Power Ventilators for Smoke Control Systems".

C. Housing: Tubular heavy gauge welded steel, housing and bearing support shall be constructed of welded structural steel member to prevent vibration and rigidly support the shaft and bearings. Windbands shall be constructed of galvanized heavy gauge steel with reinforced edges.

- D. Base (Curb Cap): Heavy gauge steel, pre-punched mounting flange and integral venturi inlet.
- E. Fan Wheels: Statically and dynamically balanced steel blades continuously welded to heavy duty hubs. A standard square key or tapered bushing shall lock the propeller to the fan shaft. Hubs shall be two piece aluminum castings that securely lock the blades in place.
- F. Belt Drives: Comply with the following:
 - 1. Provide drives sized for a minimum of 150% of driven horsepower and a minimum of two.
 - 2. Provide resilient mounting to housing.
 - 3. OSHA weatherhood and belt guard
 - 4. Belt(s):
 - a. Provide grip notch belt(s).
 - b. Provide belt tensioner.
 - 5. Provide cast iron, adjustable pitch pulleys keyed to shaft.
 - 6. Provide motor isolated from ducted airstream.
 - 7. Shaft Bearings:
 - a. Provide permanently lubricated pillow block type.
 - b. Provide sealed bearings.
 - c. Provide self-aligning type.
 - d. Provide ball bearings selected for a minimum (L10) life in excess of 100,000 hours at maximum cataloged operating speed.
 - 8. Fan Shaft:
 - a. Provide turned shaft.
 - b. Provide ground shaft.
 - c. Provide polished steel shaft.
 - d. Key shaft to fan wheel.
- G. Fan/Motor Shaft:
 - 1. Provide motor manufacturer's standard shaft.
 - 2. Key shaft to fan wheel.
- H. Motors and drives:
 - 1. Mount on vibration isolators.
 - 2. Draw air for motor cooling into the motor compartment from an area free of discharge contaminants.
 - 3. Make readily accessible for maintenance.
- I. Overload (Running) Protection:
 - 1. Provide motor overload protection as a requirement of this section.
 - 2. Provide motor overload protection as recommended by the manufacturer
 - 3. Comply with the Section 230513 "Motors for HVAC Equipment"
- J. Wind-band: Join to curb-cap with leak-proof continuously welded seam.
- K. Accessories:
 - 1. Provide disconnect switch, Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
 - 2. Provide removable, 1/2-inch mesh, aluminum or brass wire bird screen.

2.4 CENTRIFUGAL ROOF VENTILATOR(S) (DOWNBLAST, SMOKE CONTROL)

- A. Manufacturers:
 - 1. Acme Engineering & Manufacturing Corporation.
 - 2. Twin City Fan & Blower.
 - 3. Greenheck Fan Corporation.
 - 4. Loren Cook Company.
- B. Listings: UL listing for "Power Ventilators for Smoke Control Systems".
- C. Housing: Removable, spun-aluminum dome top and outlet baffle, or extruded-aluminum, rectangular top to direct discharge air downward.
- D. Base (Curb Cap): Square, one-piece, aluminum with venturi inlet cone.
- E. Fan Wheels: Statically and dynamically balanced aluminum hub and wheel with backward-inclined blades matched to inlet cone.
- F. Belt Drives: Comply with the following:
 - 1. Provide drives sized for a minimum of 150% of driven horsepower and a minimum of two.
 - 2. Provide resilient mounting to housing.
 - 3. OSHA weatherhood and belt guard
 - 4. Belt(s):
 - a. Provide grip notch belt(s).
 - b. Provide belt tensioner.
 - 5. Provide cast iron, adjustable pitch pulleys keyed to shaft.
 - 6. Provide motor isolated from ducted airstream.
 - 7. Shaft Bearings:
 - a. Provide permanently lubricated pillow block type.
 - b. Provide sealed bearings.
 - c. Provide self-aligning type.
 - d. Provide ball bearings selected for a minimum (L10) life in excess of 100,000 hours at maximum cataloged operating speed.
 - 8. Fan Shaft:
 - a. Provide turned shaft.
 - b. Provide ground shaft.
 - c. Provide polished steel shaft.
 - d. Key shaft to fan wheel.
- G. Fan/Motor Shaft:
 - 1. Provide motor manufacturer's standard shaft.
 - 2. Key shaft to fan wheel.
- H. Motors and drives:
 - 1. Mount on vibration isolators.
 - 2. Draw air for motor cooling into the motor compartment from an area free of discharge contaminants.
 - 3. Make readily accessible for maintenance.

- I. Overload (Running) Protection:
 - 1. Provide motor overload protection as a requirement of this section.
 - 2. Provide motor overload protection as recommended by the manufacturer
 - 3. Comply with the Section 230513 "Motors for HVAC Equipment"
- J. Wind-band: Join to curb-cap with leak-proof continuously welded seam.
- K. Accessories:
 - 1. Provide disconnect switch, Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
 - 2. Provide removable, 1/2-inch mesh, aluminum or brass wire bird screen.

2.5 INLINE SMOKE CONTROL FANS

- A. Manufacturers:
 - 1. Acme Engineering & Manufacturing Corporation.
 - 2. Greenheck Fan Corporation.
 - 3. Loren Cook Company.
 - 4. Twin City Fan & Blower.
- B. Housing: Manufacturer's standard steel, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.
- C. Fans selected shall be capable of accommodating static pressure and flow variations of +/-15% of scheduled values.
- D. Each fan shall be belt drive in AMCA arrangement 9.
- E. Fans are to be equipped with lifting lugs.
- F. The UL Power Ventilators for Smoke Control sticker shall be fixed to the fan housing. Fans shall be UL listed as "Power Ventilators for Smoke Control Systems" (by maximum temperature for a minimum number of hours of operation) for one of the following:
 - 1. 500°F (260°C) maximum temperature for a minimum of 4 hours of operation.
 - 2. 572°F (300°C) maximum temperature for a minimum of 2 hours of operation.
- G. After fabrication all carbon steel components shall be cleaned and chemically treated by a phosphatizing process to insure proper removal of grease, oil, scale, etc. Fan shall then be coated with a minimum of 2-4 mils of Permatector (Polyester Urethane), electrostatically applied and baked. Finish color shall be RAL 7023, concrete grey. Coating must exceed 1,000-hour salt spray under ASTM B117 test method.
- H. Each fan shall be OSHPD Seismic Certified. OSP certification number provided with submittal and labeled on the fan housing. Fans requiring seismic certification that do not have an OSHPD pre-certification shall be shake table tested at an independent test facility, shall meet an Importance Factor of 1.5, an SDS Value of 2.28, all Site Classes, all Occupancy Categories and all Seismic Design Categories (A-F).

- I. Fan Housing and Outlet
 - 1. Fan housing to be aerodynamically designed with high-efficiency inlet, engineered to reduce incoming air turbulence.
 - 2. Tubular fan housing shall be completely welded and coated with a minimum of 2-4 mils of Permator (Polyester Urethane), electrostatically applied and baked. Finish color shall be RAL 7023, concrete grey. No uncoated steel parts will be allowed.
 - 3. Housing and bearing support shall be constructed of welded structural steel members to prevent vibration and rigidly support the shaft and bearings.
 - 4. All mixed flow housings shall include vanes to straighten airflow prior to exiting the fan discharge.
 - 5. Units shall incorporate mounting system that allows for field rotation of the motor position. Bearing life shall not be reduced below specified level in different configurations. Units shall accommodate base mount or ceiling hung mounting without structural modifications to the fan.
 - 6. An access door shall be supplied for impeller inspection and service.
 - 7. OSHA compliant belt guard or motor cover to be included to completely cover the motor pulley and belt(s).

- J. Fan Impeller
 - 1. Fan impeller shall be mixed flow design. The impeller shall be electronically balanced both statically and dynamically to balance grade G6.3 per ANSI S2.19.
 - 2. Fan impeller shall be manufactured with contoured blade profiles. Impellers constructed of steel are coated with a minimum of 2-4 mils of Permator (Polyester Urethane), electrostatically applied and baked. Finish color shall be RAL 7023, concrete grey. Aluminum constructed impellers will be mill finish.
 - 3. The wheel and fan inlet shall be carefully matched and shall have precise running tolerances for maximum performance and operating efficiency.

- K. Fan Motors and Drive
 - 1. Motors shall meet or exceed EISA (Energy Independence and Security Act) efficiencies. Motors to be NEMA T-frame, 1800 or 3600 RPM, Totally Enclosed Fan Cooled (TEFC) with a 1.15 service factor with across the line starting or 1.0 service factor when used with variable frequency drive (VFD).
 - 2. Drive belts and sheaves shall be sized for 150% of the fan operating brake horsepower, and shall be readily and easily accessible for service, if required.
 - 3. Fan shaft to be turned and polished steel that is sized so the first critical speed is at least 25% over the maximum operating speed for each pressure class.
 - 4. Fan shaft bearings shall be Air Handling Quality, bearings shall be heavy-duty grease lubricated, self-aligning ball or roller pillow block type.
 - 5. Air Handling Quality bearings to be designed with low swivel torque to allow the outer race of the bearing to pivot or swivel within the cast pillow block. Bearings shall be 100% tested for noise and vibration by the manufacturer. Bearings shall be 100% tested to ensure the inner race diameter is within tolerance to prevent vibration.
 - 6. Bearings shall be selected for a minimum basic rating fatigue life (L-10) of 80,000 hours at maximum operating speed for each pressure class.
 - 7. Bearings shall have extended lube lines with Zerk fittings to allow for lubrication from the exterior of the fan.

2.6 INLINE CENTRIFUGAL FANS

- A. Manufacturers:
 - 1. Acme Engineering & Manufacturing Corporation.
 - 2. Greenheck Fan Corporation.
 - 3. Loren Cook Company.
 - 4. Twin City Fan & Blower.
- B. Housing: Manufacturer's standard steel, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.
- C. Direct-Drive Units (where indicated in Fan Schedule): Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.
- D. Electrically-Commutated Motor (where direct drive fans indicated):
 - 1. Motor enclosure: Open type.
 - 2. Motor shall be DC electronic commutation type motor (ECM).
 - 3. Motor shall be permanently lubricated, heavy duty ball bearing type to match with the fan load and prewired to the specific voltage and phase.
 - 4. Internal motor circuitry to convert AC power supplied to fan to DC power to operate motor.
 - 5. Motor shall be speed controllable down to 20% of full speed. Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.
- E. Belt-Driven Units (where indicated in Fan Schedule): Motor mounted on adjustable base, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.
- F. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.
- G. Provide accessories:
 - 1. Companion Flanges: For inlet and outlet duct connections.
 - 2. Motorized Backdraft Damper(s): Provide damper(s) with electric actuator(s) wired to close when fan stops and open with fan is on. Actuator voltage shall match fan motor voltage. Where matching actuator and fan voltage is not possible, fan manufacturer shall provide transformer to produce compatible voltage to actuator. Wiring of fan and backdraft damper actuator(s) shall be by Division 26.
 - 3. When fan motor is not electronically commutated (EC), provide integrated speed controller for final balancing.

2.7 MOTORS

- A. Refer to section "Common Motor Requirements for HVAC Equipment."
- B. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors.

1. Motor Sizes: Size shall be as indicated. If not indicated, provide motor large enough to drive load and avoid operation in service factor range above 1.0.
2. Controls: Provide controllers, electrical devices, and wiring to comply with requirements specified in Division 26 Sections.

C. Enclosure Type: Totally enclosed, fan cooled.

2.8 FASTENERS

- A. Security: Button head 1/4" diameter by 1-1/4" long (minimum size) sheet metal screws with torx head and center reject pin.
- B. Refer to paragraph "SUBMITTALS"

2.9 SOURCE QUALITY CONTROL

- A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

2.10 ROOF CURB:

- A. Dishwasher and Grease Hoods: Curbs for fans serving this equipment have special dimensional requirements. Provide dimensions indicated.
- B. Minimum Height from Top of Roof Insulation for Non-Grease Fans: 12".
- C. Slope: Match structure. Top of curb shall be level and each edge shall be flush with other edges on all sides.
- D. Curb Material: Match material of power ventilator located on roof curb.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install HVAC Power Ventilators level and plumb.
- B. Secure roof-mounted fans to roof curbs with security fasteners. Refer to Section "Roof Accessories" for other installation requirements for roof curbs.

- C. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
- D. Support suspended units from structure using threaded steel rods and elastomeric hangers having a static deflection of 0.5 inches.
- E. Install units with clearances for service and maintenance.
- F. Label units.
- G. Kitchen Hood Fans:
 - 1. Install roof-mounted exhaust fans with fan discharge a minimum of 40" above the finished roof surface. Outlet shall be not less than 10 feet horizontally from parts of the same building and adjacent buildings. Outlet shall be not less than 10 feet above adjoining grade level. Outlet shall be not less than 10 feet horizontally from or not less than 3 feet above air intake openings into any building.
 - 2. Install sidewall exhaust fans not less than 10 feet above adjoining grade level. Outlet shall be not less than 10 feet horizontally from or not less than 3 feet above air intake openings into any building. Termination shall not be located where protected openings are required and shall not be located within 3 feet of exterior openings.

3.2 FIELD QUALITY CONTROL

- A. 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.
- B. Tests and Inspections:
 - 1. Verify that Shipping blocking and bracing are removed.
 - 2. Verify that unit is secure and connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. For belt drive units disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align belts, adjust belt tension, and install belt guards.
 - 5. Adjust damper linkages & operators for proper damper operation.
 - 6. Verify lubrication for bearings and other moving parts.
 - 7. Verify that manual and automatic volume control, fire, smoke, and fire/smoke dampers in connected ductwork systems are in a fully open position.
 - 8. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm.
 - 9. Measure and record motor voltage and amperage.
 - 10. Shut unit down and reconnect automatic temperature-control operators.
 - 11. Remove and replace malfunctioning units and retest as specified above.

- C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Prepare test and inspection reports.

3.3 TESTING, ADJUSTING, BALANCING, AND LUBRICATION

- A. Adjust damper linkages for proper damper operation.
- B. Comply with requirements in Section "Testing, Adjusting, and Balancing for HVAC".
- C. Replace fan and motor pulleys to achieve design airflow.
 - 1. Disable automatic temperature-control operators, energize motor and adjust fan to required rpm.
 - 2. Measure and record RPM.
 - 3. Measure and record motor voltage and amperage.
- D. Re-lubricate bearings.

END OF SECTION 233423

SECTION 233600 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 ABBREVIATIONS

- A. BAS Building Automation System.
- B. CFM Cubic Feet per Minute.
- C. ECM Electronically Commutated Motor.
- D. PSIG Pounds per Square Inch Gauge.
- E. PSC Permanent Split Capacitor
- F. SCR Silicon Controlled Rectifier.
- G. VA Volt Amps. (A measure of transformer power)

1.3 SUBMITTALS

- A. Product Data: For each type of the following products, including rated capacities, furnished specialties, sound-power ratings, and accessories.
 - 1. Air terminal units.
 - 2. Liners and adhesives.
 - 3. Sealants and gaskets.
- B. Shop Drawings: For air terminal units. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
 - 3. Hangers and supports, including methods for duct and building attachment, bracing, and vibration isolation.

- C. 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. 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. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

PART 2 - PRODUCTS

2.1 SHUTOFF AIR TERMINAL UNITS

- A. Manufacturers:
 - 1. Carnes.
 - 2. Nailor Industries, Inc.
 - 3. Titus.
 - 4. Trane.
- B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.

Casing: Single wall galvanized sheet steel.

- 1. Sheet Metal Thickness: Manufacturer's standard.
 - 2. Casing Lining: Adhesive attached 1", fiberglass liner having a maximum flame spread index of 25 and a maximum smoke developed index of 50. Insulation shall comply with UL 181 erosion requirements.
 - 3. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment. Provide flexible connector.
 - 4. Air Outlet: S-slip and drive connections. Provide flexible connector.
 - 5. Access: Removable panels with airtight gaskets for access to parts requiring service, adjustment, or maintenance.
 - 6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
 - 1. Damper Position: Normally open.

- D. When indicated provide a Hydronic Heating Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1", tested at 300 PSIG and rated for a minimum working pressure of 200 PSIG at a maximum entering-water temperature of 220° F. Include manual air vent and drain valve.
- E. Factory mounted and wired components:
 - 1. Electrical components mounted in control box with removable cover. Incorporate single point electrical connection to power source.
 - 2. Control Transformer: 50 VA minimum factory mounted transformer for control voltage. Input voltage shall match the circuit provided. Coordinate output voltage with contractor performing work under Section "Building Automation System". Provide terminal strip in control box and field wiring of BAS unit controller to terminal strip. Wiring shall be as indicated.
 - 3. Wiring Terminations: Fan and controls to terminal strip. Terminal lugs to match quantities, sizes, and materials of branch-circuit conductors and BAS requirements. Enclose terminal lugs in terminal box sized according to NFPA 70.
 - 4. Disconnect Switch: Factory mounted fused.
- F. Control Sequence:
 - 1. As indicated in Section "Sequences of Control."

2.2 HANGERS AND SUPPORTS

- A. Hanger Rods: Cadmium-plated steel rods, neoprene 1/8" thick washers and nuts.
 - 1. Vibration isolation washers should be used on both sides of threaded rod attachment to box to prevent vibration transmission to structure.
- B. 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.
- C. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- D. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

2.3 SOURCE QUALITY CONTROL

- A. Label each air terminal unit with tag, nominal airflow, maximum and minimum factory-set airflows, coil type if coil is included, and ARI certification seal.
- B. For hydronic coils include hose kit and control valve shrink wrapped and labeled with terminal unit tag.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "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 and for slabs equal to or more than 4" thick.
 - 4. Do not use powder actuated concrete fasteners for lightweight aggregate concretes and for slabs less than 4" thick.
 - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.
- D. 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.

3.3 CONNECTIONS

- A. Install piping adjacent to air terminal unit to allow service and maintenance.
- B. Hot-Water Piping: In addition to requirements in Division 23 Section "Hydronic Piping," connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.
- C. Connect ducts to air terminal units according to division 23 duct specification sections for metal and flexible ducts.
- D. Make connections to air terminal units with flexible connectors complying with requirements in Division 23 Section "Air Duct Accessories."

3.4 IDENTIFICATION

- A. Label each air terminal unit with tag, nominal airflow, and maximum and minimum factory set airflows. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for equipment labels and warning signs/labels.

3.5 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. Tests and Inspections:
 - 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. Air terminal unit will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 233600

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, mounting details, and performance data including throw, 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.

PART 2 - PRODUCTS

2.1 DIFFUSERS, GRILLES, AND REGISTERS

- A. Manufacturers:
 - 1. Anemostat.
 - 2. Carnes.
 - 3. Krueger.
 - 4. MetalAire, Inc.
 - 5. Nailor Industries.
 - 6. Price Industries.
 - 7. Titus.
 - 8. Tuttle & Bailey.
- B. General:
 - 1. The basis of design for each grille register and diffuser is indicated on the drawings. The contractor shall provide equivalent products by one of the listed manufacturers.
 - 2. Where aluminum construction is indicated blades and frames shall be extruded.
 - 3. All trim pieces shall be mechanically fastened. Friction fit trim rings/frames shall not be provided or shall be mechanically fastened in the field. Fasteners shall not be visible.
 - 4. Finish:
 - a. Powder-coated or baked enamel, white, unless noted otherwise.

- b. For sidewall-mounted inlets and outlets, provide finish suitable for field painting where indicated (color shall be selected by Architect) or provide anodized clear finish where indicated.
 - c. Finish for Exposed Ductwork: Where ductwork is exposed, inlets and outlets mounted in exposed ductwork shall be factory painted with custom color selected by Architect.
- 5. Filter Grille Mounting Frame: Shall accept a 2" deep MERV 8 (30%) pleated media filter. Refer to Section "Particulate Air Filtration" for filter requirements. Provide two sets of filters for each filter grille.
- 6. Mounting: As Scheduled.
- 7. Damper Type: Adjustable opposed-blade assembly where damper is indicated on the schedule.
- 8. All spiral mounted exposed grilles shall match ductwork curve similar to basis of design selections or equal.

C. Linear Slot Diffuser Plenums

- 1. Linear slot diffuser plenums shall be fully insulated. Provide one of the following:
 - a. Factory-installed, internal fiberglass insulation on sides and end caps.
 - b. Factory-installed, external aluminum foil-backed insulation.
 - c. Field-installed external insulation on plenums not factory-insulated. Refer to Section 230700 HVAC Insulation.

D. Ceiling Diffusers

- 1. Ceiling diffuser backpans shall be externally insulated. Provide one of the following:
 - a. Factory-installed with foil/scrim vapor barrier insulation with an R-value of six.
 - b. Field-installed external insulation on backpans not factory-insulated. Refer to Section 230700 HVAC Insulation.

2.2 SECURITY REGISTERS AND GRILLES

A. Manufacturers:

- 1. A & J Manufacturing.
- 2. Anemostat.
- 3. Krueger.
- 4. Kees
- 5. MetalAire, Inc.
- 6. Price Industries.
- 7. Titus.
- 8. Safety Concepts; S-vent.

B. Material: Steel.

C. Finish: Baked enamel, white.

D. Maximum Security Grilles Only - Face Arrangements:

1. 3/16-inch-thick perforated faceplate with 3/16-inch diameter holes spaced 9/32 inch on center, staggered at 60 degrees.
2. Provide manual volume damper adjustable through face of grille.

E. Wall Sleeve: 3/16" steel mechanically fastened to border.

F. Damper Type: Adjustable opposed-blade assembly where indicated on schedule.

2.3 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 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Install diffusers, registers, and grilles flush with ceiling unless otherwise indicated in contract documents.
- C. 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. Install in locations indicated, as much as practical. For units installed in lay-in ceiling panels, center units in both directions in panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- D. Linear Slot Diffuser Installation: Adjust each slot diffuser so half the slots throw horizontally along the ceiling in each direction unless indicated otherwise on drawings. For linear slot diffusers above windows at building perimeter, one half of the total slots at each diffuser shall be adjusted to throw air vertically downward to wash window, and the other half of the slots shall be adjusted to throw air horizontally across ceiling unless indicated otherwise.
- E. Diffusers, registers and grilles shall be supported independently of the ceiling system and shall not be supported from conduit, piping or unrelated ductwork.

- F. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance.

3.3 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 238123 – COMPUTER ROOM AIR CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The Drawings and the general provisions of the Contract Documents apply to this Section.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For computer-room air conditioners. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Color Samples: For unit cabinet, discharge grille, and exterior louver and for each color and texture specified.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: For computer-room air conditioners to include in emergency, operation, and maintenance manuals.
- F. Warranty: Sample of special warranty.

1.3 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. ASHRAE Compliance:
 - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2013.

1.4 COORDINATION

- A. Coordinate layout and installation of computer-room air conditioners 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.
- B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of computer-room air conditioners that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
 - 2. Warranty Period for Humidifiers: Manufacturer's standard, but not less than three years from date of Substantial Completion.
 - 3. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

1.6 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. Fan Belts: One set(s) for each belt-driven fan.
 - 2. Filters: One set(s) of filters for each unit.

PART 2 - PRODUCTS

2.1 FLOOR-MOUNTED UNITS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Compu-Aire, Inc.
 - 2. Data Aire Inc.
 - 3. Koldwave, Inc.; a Mestek company.
 - 4. Liebert Corporation (Vertiv).
- B. Description: Self-contained, factory assembled, prewired, and prepiped; consisting of cabinet, fan, filters, and controls.
- C. Cabinet and Chassis: Constructed of heavy gauge galvanized steel with baked-enamel finish and shall be serviceable from only one side. Internal cabinet shall be insulated with 1/2-inch-

thick duct liner that meets ASHRAE Standard 62.1 requirements for mold growth and has been tested per UL 181 standards.

- D. Air Distribution: The fan shall be a belt drive, centrifugal type, double width, double inlet. The shaft shall be heavy-duty steel with self-aligning ball bearings with minimum life of 100,000 hours. The fan motor shall be 1750 rpm and mounted on an adjustable base. The drive package shall be equipped with an adjustable motor pulley. The fan/motor assembly shall be mounted on vibration isolators.
- E. Microprocessor Control: The control system shall be microprocessor-based, factory-wired into the system cabinet and tested prior to shipment. The unit-mounted control enclosure shall include a 2-line by 16-character liquid crystal display (LCD) providing continuous display of operating status and alarm condition which is wired into the control board using 4-conductor field-supplied wire. A 7-key membrane keypad for set point/program control and unit On/Off shall be located below the display. The control shall be capable of displaying values in °F. The microprocessor shall provide three stages of cooling for direct expansion units by cycling the compressors. The microprocessor shall determine the optimal stage to run based on historical run data. Temperature and humidity sensors shall be located on unit.
 - 1. Monitoring: The LCD shall provide an On/Off indication, operating mode indication (cooling, heating, humidifying, dehumidifying) and current day, time, temperature and humidity indication.
 - a. Control Set points:
 - 1) Temperature Set point: 65-85°F
 - 2) Temperature Sensitivity: 1-9.9°F
 - 3) Humidity Set point: 20-80% RH
 - 4) Humidity Sensitivity: 1-30% RH
 - b. Unit Controls:
 - 1) Compressor Short-Cycle Control: The control system shall prevent compressor short cycling by a three minute timer from compressor stop to the next start.
 - 2) Common Alarm and Remote On/Off: A common alarm relay shall provide a contact closure to a remote alarm device. Two (2) terminals shall also be provided for remote On/Off control. Individual alarms shall be “enabled” or “disabled” from reporting to the common alarm.
 - 3) Setback Control: The control shall be user-configurable to use a manual set point control or a programmable, time-based setback control. The setback control will be based on a 5 day/2 day programmed weekly schedule with capability of accepting 2 events per program day.
 - 4) Temperature Calibration: The control shall include the capabilities to calibrate the temperature and humidity sensors and adjust the sensor response delay time from 10 to 90 seconds. The control shall be capable of displaying temperature values in °F or °C.
 - 5) System Auto Restart: For startup after power failure, the system shall provide automatic restart with a programmable (up to 9.9 minutes in 6-second increments) time delay. Programming shall be possible at the unit-mounted controller.
 - c. Alarms:

- 1) Unit Alarm: The control system shall monitor unit operation and activate an audible and visual alarm in the event of the following factory preset alarm conditions:
 - a) High/Low temperature
 - b) High/Low Humidity
 - c) High water alarm – lockout unit operation
 - d) High head pressure
 - e) Power loss
 - f) Compressor short cycle
 - g) Humidifier alarm
 - 2) Alarm controls: Each alarm shall be individually enabled or disabled (except for high head pressure and high water in condensate pan) and can be programmed for a time delay of 0-255 seconds of continuous alarm condition to be recognized as an alarm. Each alarm can also be enabled or disabled to activate the common alarm (except high head pressure and high water in condensate pan).
 - 3) Audible Alarm: The audible alarm shall annunciate at the LCD.
 - 4) Common Alarm: A programmable alarm shall be provided to interface user selected alarms with the BAS.
2. Provide unit with BACnet IP interface for connection the Building Automation System. At a minimum, the BACnet IP interface shall provide the following data to the BAS head end. The following points shall be R/W are read/write points, RD are read only points.
- a. Space Air Temperature Setpoint (R/W)
 - b. Space Humidity Setpoint (R/W)
 - c. Supply Air Temperature (RD)
 - d. High Space Temperature Alarm (R/W)
 - e. Low Space Temperature Alarm (R/W)
 - f. High Space Humidity Alarm (R/W)
 - g. Low Space Humidity Alarm (R/W)
 - h. Humidifier Utilization (RD)
 - i. Dehumidifier Utilization (RD)
 - j. Cooling Capacity (RD)
 - k. Chilled Water Valve Position (RD)
 - l. Electric Heating Capacity (RD)
- F. Evaporator Coil: The evaporator section shall include evaporator coil, thermostatic expansion valve and filter driers. The evaporator coil shall have two circuits constructed of copper tubes and aluminum fins. Externally equalized thermostatic expansion valves shall control refrigerant flow. The evaporator unit shall be factory-charged with refrigerant and sealed. The coil shall be provided with a condensate drain pan, with an internally trapped drain line. The evaporator drain pan shall include a factory-installed float switch to shut down the evaporator upon high water condition.
- G. Chilled Water Coil
1. Factory tested to 300 PSIG according to ARI 410 and ASHRAE 33.
 2. Comply with ARI 410 & ASHRAE 62.1.
 3. Fabricate coil section to allow removal and replacement of coil for maintenance and to allow in-place access for service, maintenance, and cleaning of coil(s).
 4. Coils shall not act as a structural component of the unit.

- H. Outdoor Air-Cooled Propeller Fan Condensing Unit: The condenser coil shall be constructed of copper tubes and aluminum fins with a direct-drive propeller-type fan, and shall include multiple compressors, high-pressure switches, refrigerant receivers, head pressure control valves and liquid line solenoid valves. All components shall be factory-assembled, charged with refrigerant and sealed. No internal piping, brazing, dehydration or charging shall be required. Condensing unit shall be designed for 95°F ambient and be capable of operation to -30°F. Hot gas bypass shall be provided for each circuit to reduce compressor cycling and optimize performance under low load conditions.
- I. Humidifier: The environmental control system shall be equipped with a steam generating humidifier that is controlled by the microprocessor control system. It shall be complete with disposable canister, all supply and drain valves, 1" air gap on fill line, inlet strainer, steam distributor and electronic controls. The need to change canister shall be annunciated on the microprocessor wall box control panel. An LED light on the humidifier assembly shall indicate cylinder full, overcurrent detection, fill stem fault and end of cylinder life conditions.
- J. Electric Reheat: The electric reheat shall be low-watt density, 304/304 stainless steel, finned-tubular and shall be capable of maintaining room dry bulb conditions when the system is calling for dehumidification. The reheat section shall include an agency-approved safety switch to protect the system from overheating and shall be controlled in stages.
- K. Disconnect Switch: The non-automatic, non-locking, molded case circuit interrupter shall be factory mounted in the high-voltage section of the electrical panel. The switch handle shall be accessible from the unit front and mounted on the evaporator unit.
- L. Accessories:
 - 1. Remote Sensors: Provide remote temperature and humidity sensors. Sensors shall be connected by a shielded cable.
 - 2. Air Filter Box: Evaporator section shall include an air filter box for deep pleated type, MERV 8 rated filters.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, floors, and roofs for suitable conditions where computer-room air conditioners will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install computer-room air conditioners level and plumb, maintaining manufacturer's recommended clearances.
- B. Install ground mounted condensing units on equipment pad and per 230548, section 3.7 for Condensing Units.

- C. Install floor mounted indoor units per Indoor Air Handling Units per 230548, section 3.7.

3.3 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 machine to allow service and maintenance.
- C. Water and Drainage Connections: Comply with applicable requirements in Division 22 Section "Domestic Water Piping." Provide adequate connections for water-cooled units, condensate drain, and humidifier flushing system.
- D. Refrigerant Piping: Comply with applicable requirements in Division 23 Section "Refrigerant Piping." Provide shutoff valves and piping.

3.4 FIELD QUALITY CONTROL

- A. 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.
- B. Tests and Inspections:
 - 1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
 - 2. After installing computer-room air conditioners and after electrical circuitry has been energized, test for compliance with requirements.
 - 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. Computer-room air conditioners will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. After startup service and performance test, change filters and flush humidifier.

3.5 ADJUSTING

- A. Adjust initial temperature and humidity set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain computer-room air conditioners.

END OF SECTION 238123

DETENTION ANNEX RENOVATION
WAKE COUNTY, NORTH CAROLINA
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SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.

1.3 DEFINITIONS

- A. RACEWAY: An enclosed channel of metal or nonmetallic materials designed expressly for holding wires or cables. Raceways include, but are not limited to, rigid metal conduit, rigid nonmetallic conduit, intermediate metal conduit, liquidtight flexible conduit, flexible metallic tubing, flexible metal conduit, electrical nonmetallic tubing, and electrical metallic tubing.
 - 1. Cables such as MC, AC, or Greenfield are NOT raceways.

1.4 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Cerro Wire LLC.
 - 2. General Cable; General Cable Corporation.
 - 3. Southwire Company.
 - 4. Encore Wiring Corporation.
- B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.

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- C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-2-THWN-2.
- D. Multiconductor Cable:
 - 1. Shall only be allowed where specially indicated on the drawings.
 - 2. Comply with NEMA WC 70/ICEA S-95-658 for metal-clad cable, Type MC with ground wire.

2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. 3M.
 - 2. Hubbell Power Systems, Inc.
 - 3. ILSCO.
 - 4. Tyco Electronics Corp.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SYSTEM DESCRIPTION

- 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. Comply with NFPA 70.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Cooper unless Aluminum specifically indicated on the drawings
 - 1. When aluminum feeders are allowed, provide Copper for feeders smaller than No. 4 AWG; copper or aluminum for feeders No. 4 AWG and larger. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-2-THWN-2, conductors in raceway or Type XHHW-2, single conductors in raceway. Type SE or Type USE multiconductor cable are not allowed.
- B. Exposed Feeders: Type THHN-2-THWN-2, conductors in raceway.

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- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-2-THWN-2, conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2 conductors in raceway.
- E. Exposed Branch Circuits, Including in Crawlspace: Type THHN-2-THWN-2, conductors in raceway
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-2-THWN-2, conductors in raceway.
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, conductors in raceway, Type XHHW-2, conductors in raceway.
- H. Feeders and Branch Circuits are not permitted to be installed in Cable Tray

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Branch Circuits Concealed in Casework: MC cable may be used to feed to outlet boxes fish concealed in built-in casework. Route cable supported tight in upper inside corners of casework, not in conflict with drawers or cabinet doors.
- G. Branch Circuits Concealed Existing to Remain Drywall Partitions: MC cable may be used to feed to outlet boxes fish concealed in the drywall partition. Convert to conduit and conductor with 3' of exiting the partition.
- H. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."
- I. Whips from Junction Box Concealed in Ceilings to Lighting Fixtures:
 - 1. Type MC Cable or FMC, with minimum #12AWG copper THHN/THWN and full size equipment grounding conductor. Maximum whip length 72".

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2. MC Cable and FMC shall be supported within 24" of fixture connection so that whip is not in contact with ceiling or grid. Securing to fixture support wires with batwings is acceptable but not to ceiling support wires.
 3. Do not connect fixture whips from fixture to fixture (daisy chain). No more than 4 whips shall be connected to any one junction box.
- J. AC cable is not acceptable in any application.
- K. All single-phase circuits shall include a dedicated neutral (grounded) and grounding conductor, unless specifically noted otherwise.
1. The intent of this is to eliminate multiwire branch circuits and allow disconnection of one circuit without requiring disconnection of other(s) as would be required to comply with NEC 210.4(B). Per NEC 310.15(B)(b) each of these neutral (grounded) conductor is not considered to be load-bearing so derating is not required.
- L. Contract drawings are based upon a maximum of 3 current-carrying conductors in a conduit. Contractor may rework indicated circuitry to install a maximum of (6) L-N circuits (120 or 277V) in a single conduit. There shall be no more than 2 each A, B, C phase conductors per homerun. Each shall have dedicated neutral (grounded) conductor.
1. Do not group L-L circuits in a homerun, unless specifically indicated on the drawings.
 2. Where there are more than 3 current-carrying conductors in a conduit, derate conductor ampacities in accordance with NEC Table 310.15(B)(2)(a).
 3. When running more than 3 ungrounded conductors in a raceway, increase size of conduits beyond those indicated in contract documents, as required to not exceed NEC Chapter 9, Table 1 conduit-fill requirements. As-built drawings shall clearly indicate which circuits are grouped in homeruns.
- M. Unless otherwise indicated, minimum conductor size shall be 12 AWG.

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors where permitted.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

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- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
 - a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
 - b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- B. Test and Inspection Reports: Prepare a written report to record the following:
 - 1. Procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- C. Cables will be considered defective if they do not pass tests and inspections. Remove and replace malfunctioning cables and retest as specified above.

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END OF SECTION 260519

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SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes grounding and bonding systems and equipment

1.3 ACTION SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Burndy; Part of Hubbell Electrical Systems.
 - 2. ERICO International Corporation.
 - 3. Galvan Industries, Inc.; Electrical Products Division, LLC.
 - 4. ILSCO.
 - 5. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.

2.2 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

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2.3 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Grounding Electrode Conductors: For the main service and transformers within the building shall be bare stranded copper and shall be sized no smaller than that indicated on the drawings or in the NEC table 250-66.
- C. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.5 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.
 - 1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches long.
 - 2. Backfill Material: Electrode manufacturer's recommended material.

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PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches below grade.
- C. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, tele-data rooms and elsewhere as indicated.
- D. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

- A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

3.4 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- C. Metallic Fences:
 - 1. Grounding Conductor: Bare copper, not less than No. 8 AWG.
 - 2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
 - 3. Barbed Wire: Strands shall be bonded to the grounding conductor.

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3.5 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. When provided, Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 - 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- E. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- F. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

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3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Report measured ground resistances that exceed 10 ohms.
- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL 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. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Support Systems.

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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. Cooper B-Line, Inc.; a division of Cooper Industries.
 - b. ERICO International Corporation.
 - c. Thomas & Betts Corporation.
 - d. Unistrut; an Atkore International company.
 2. Metallic Coatings: Hot-dip galvanized or zinc plated after fabrication. Selected for applicable load criteria.
- B. Raceway and Cable Supports: As required by NEC except in secure areas, the distance between supports shall be one half that specified by NEC. (twice as many supports as required by NEC).
- C. Conduit and Cable Support Devices: Steel hangers, two-hole straps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces shall be tamperproof include the following:
1. Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.

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- 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 6. Toggle Bolts: All-steel springhead type.
 7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 1. Secure raceways and cables to these supports with two-bolt conduit clamps.

3.2 SUPPORT INSTALLATION

- A. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

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- B. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
1. To Wood: Fasten with lag screws or through bolts.
 2. To New Concrete: Bolt to concrete inserts.
 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 4. To Existing Concrete: Expansion anchor fasteners.
 5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 6. To Light Steel: Sheet metal screws.
 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- C. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete.
- C. Anchor equipment to concrete base.
1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

END OF SECTION 260529

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SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL 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 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. RGS: Rigid Galvanized Steel conduit.
- C. FMC: Flexible metal conduit.
- D. IMC: Intermediate metal conduit.
- E. LFMC: Liquidtight flexible metal conduit.
- F. LFNC: Liquidtight flexible nonmetallic conduit.
- G. NBR: Acrylonitrile-butadiene rubber.
- H. RNC: Rigid nonmetallic conduit.
- I. PVC: Schedule 40 PVC
- J. ACCESSIBLE: Conduit less than 12' above the finished floor that is capable of being exposed without damaging the building structure or finish or not permanently closed in by the structure or finish of the building. Example: Conduit below 12' AFF that is above a removable ceiling tile is considered "Accessible"
- K. SECURE: Area in which inmates have supervised or non-supervised access on a routine or constant basis. Refer to Architectural drawings for the areas designated as secure. If not clearly defined, the space shall be deemed as secure.
- L. RACEWAY: An enclosed channel of metal or nonmetallic materials designed expressly for holding wires or cables. Raceways include, but are not limited to, rigid metal conduit, rigid nonmetallic conduit, intermediate metal conduit, liquidtight flexible conduit, flexible metallic tubing, flexible metal conduit, electrical nonmetallic tubing, and electrical metallic tubing.
 - 1. Cables such as MC, AC, or Greenfield are NOT raceways.

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1.3 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Allied Tube & Conduit.
 - 2. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
 - 3. Robroy Industries.
 - 4. Thomas & Betts Corporation.
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. IMC: Comply with ANSI C80.6 and UL 1242.
- E. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
 - 1. Comply with NEMA RN 1.
 - 2. Coating Thickness: 0.040 inch, minimum.
- F. EMT: Comply with ANSI C80.3 and UL 797.
- G. FMC: Comply with UL 1; zinc-coated steel.
- H. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- I. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
 - 1. Fittings for EMT: Steel compression type.
 - 2. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
 - 3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
- J. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

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2.2 NONMETALLIC CONDUITS, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Electri-Flex Company.
 - 3. RACO; Hubbell.
 - 4. Thomas & Betts Corporation.
- B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. PVC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2. Hoffman; a brand of Pentair Equipment Protection.
 - 3. Square D.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, unless otherwise indicated, and sized according to NFPA 70.
 - 1. Metal wireways installed outdoors shall be listed and labeled NEMA 3R, Flanged-and-gasketed type, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Screw-cover type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways shall be listed and labeled as defined in NFPA 70, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect].

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1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. MonoSystems, Inc.
 - b. Panduit Corp.
 - c. Wiremold / Legrand.

2.5 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. EGS/Appleton Electric.
 2. Erickson Electrical Equipment Company.
 3. Hoffman; a brand of Pentair Equipment Protection.
 4. Hubbell Incorporated.
 5. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
 6. RACO; Hubbell.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy or aluminum, Type FD, with gasketed cover.
- E. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- G. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum or galvanized, cast iron with gasketed cover.
- H. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- I. Gangable boxes are not prohibited.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
 1. Exposed Conduit: GRC.

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2. Concealed Conduit, Aboveground: GRC.
 3. Concealed in Masonry: GRC or PVC grouted solid after installation. Convert to metallic conduit per this specification prior to exiting the wall above ground.
 4. Concealed in Poured Concrete Walls: GRC or PVC. Convert to metallic conduit per this specification prior to exiting the wall above ground.
 5. Underground Conduit: Type PVC, direct buried.
 6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 7. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R
- B. Indoors Secure Locations: Apply raceway products as specified below unless otherwise indicated:
1. Exposed, GRC.
 2. Concealed in Ceilings Above 12' and Interior Walls and Partitions: EMT.
 3. Concealed in Masonry: GRC or PVC grouted solid after installation. Convert to metallic conduit per this specification prior to exiting the wall above ground.
 4. Concealed in Poured Concrete Walls: GRC or PVC. Convert to metallic conduit per this specification prior to exiting the wall above ground.
 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 6. Damp or Wet Locations: GRC.
 7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
 8. Concealed in Ceilings below 12': GRC.
- C. Indoors Non-secure Locations: Apply raceway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
 2. Exposed and Subject to Physical Damage: GRC. Raceway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 4. Concealed in Masonry: GRC or PVC grouted solid after installation. Convert to metallic conduit per this specification prior to exiting the wall above ground.
 5. Concealed in Poured Concrete Walls: GRC or PVC. Convert to metallic conduit per this specification prior to exiting the wall above ground.
 6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 7. Damp or Wet Locations: GRC.
 8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- D. Minimum Raceway Size: 3/4-inch trade size.
- E. Raceway Fittings: Compatible with raceways and suitable for use and location.

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1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
Concealed conduit to the greatest extent possible. For all exposed and accessible conduit within the secure perimeter, provide RGS, IMC unless otherwise noted on the drawings. Refer to Architectural drawings for secure perimeter.

F. Whips from Junction Box Concealed in Ceilings to Lighting Fixtures:

1. Above non-removeable or security type ceilings, junction boxes are not acceptable. Provide conduit between the fixtures.
2. Within the secure perimeter, above accessible ceilings, provide Interlocked Electrical Flexible Conduit connection whips in maximum length of 4'-0". Standard FMC or MC is not acceptable in this application.
3. Above accessible ceilings outside the secure perimeter provide FMC or MC connection whips in maximum length of 6'-0".

G. AC is not acceptable in any application.

H. Do not install aluminum conduits, boxes, or fittings.

I. Install surface raceways only where indicated on Drawings.

J. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. All conduit shall be tight to the structure and secured with two-hole steel conduit straps. Unless indicated otherwise on the drawings, for all exposed or accessible conduit inside the secure perimeter, the distance between supports shall be one half that specified by NEC. (twice as many supports as required by NEC).
- C. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- D. Complete raceway installation before starting conductor installation.
- E. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

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- F. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- G. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- H. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- I. All conduit to be installed on exterior masonry shall not run continuously within the wall cavity.
- J. Support conduit within 6 inches of enclosures to which attached.
- K. Raceways Embedded in Slabs are not permitted, except as required for entry into recessed floor boxes. Conduits shall be routed below the slab within the porous fill and stub-up at the required location. Transition from PVC to RGS with RGS elbow before rising above the floor. After RGS elbow, stub-up conduit shall be type indicated in Part 3.1 above. PVC shall not be permitted exposed above the floor.
- L. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.
- M. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
- N. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for raceways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- O. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- P. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- Q. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- R. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- S. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

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- T. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- U. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- V. Special Fittings and Installations:
 - 1. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
 - 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.
 - 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
 - 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- W. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 - 1. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- X. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements and also refer to Architectural elevations. Install boxes with height measured to center of box unless otherwise indicated.
- Y. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box. Retain the fire rating of any fire rated wall or assembly.
- Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- AA. Locate boxes so that cover or plate will not span different building finishes.

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- BB. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- CC. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- DD. Set metal floor boxes level and flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom for pipe less than 6 inches in nominal diameter.
2. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
3. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
 - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
4. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install handholes with bottom below frost line, below grade.

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3.5 BOX AND CONDUIT COLOR CODING

- A. All outlet boxes, junction boxes and pull boxes shall have their covers and exterior visible surfaces painted with colors to match the surface color scheme outlined below. This includes covers on boxes above lift-out and other type accessible ceilings, where identification shall also include branch circuit designation. Mark conduit a minimum of each 10'-0"

System	Junction Box & Cover	Conduit Color	Raceway Labels
120/208V	Galvanized	Galvanized	
277/480V	Black	Galvanized	
Emergency Systems	Green	Green	
Data Systems	Brown	Orange	
Paging	White	Orange	
Fire Alarm	Bright Red	Red	White
HVAC Controls	Galvanized	Blue	
Intercom	Galvanized	Yellow	Orange
Access Control	Galvanized	Yellow	Green
Video Surveillance	Galvanized	Yellow	Blue
Network Backbone	Galvanized	Yellow	Yellow

3.6 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Maintain the fire rating of all fire rated walls and assemblies in which electrical raceway or boxes are installed.

END OF SECTION 260533

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SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Direct-buried conduit, ducts, and duct accessories.
- 2. Concrete-encased conduit, ducts, and duct accessories.
- 3. Handholes and boxes.
- 4. Manholes.

1.3 DEFINITIONS

- A. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

1.4 ACTION SUBMITTALS

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

- 1. Include ductbank materials, including separators and miscellaneous components.
- 2. Include ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
- 3. Include accessories for manholes, handholes, boxes.
- 4. Include warning tape.

- B. Shop Drawings:

- 1. Precast or Factory-Fabricated Underground Utility Structures:
 - a. Include plans, elevations, sections, details, attachments to other work, and accessories.
 - b. Include duct entry provisions, including locations and duct sizes.
 - c. Include reinforcement details.
 - d. Include frame and cover design and manhole frame support rings.
 - e. Include grounding details.
 - f. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
 - g. Include joint details.

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2. Factory-Fabricated Handholes and Boxes Other Than Precast Concrete:
 - a. Include dimensioned plans, sections, and elevations, and fabrication and installation details.
 - b. Include duct entry provisions, including locations and duct sizes.
 - c. Include cover design.
 - d. Include grounding details.
 - e. Include dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

1.5 FIELD CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide temporary electrical service according to requirements indicated:
 1. Notify Owner no fewer than ten business days in advance of proposed interruption of electrical service.
 2. Do not proceed with interruption of electrical service without Owner's written permission.
- B. Ground Water: Assume ground-water level is 12 inches below ground surface unless a higher water table is noted on Drawings.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR DUCTS AND RACEWAYS

- A. Comply with ANSI C2.
- B. Install underground conduits and ductbanks per the table below. Locate a minimum of 3 feet from other utility systems (steam, chilled water, sewer, storm, etc.).
 1. Install not less than 4- #4 reinforcing bars tied to a square cage at 8' centers for conduits in ductbank under roadways.
 2. Concrete encased with a minimum envelope of 3" around each conduit *where encasement is required*.
- C. Fire pump feeders shall be, 3000 psi red concrete encased PVC-Sched 40 or GRS 36" below grade or 18" below the building slab.

2.2 CONDUIT

- A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.
- B. RNC: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

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2.3 NONMETALLIC DUCTS AND DUCT ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. ARNCO Corp.
 2. Electri-Flex Company.
 3. Lamson & Sessions.
 4. Spiraduct/AFC Cable Systems, Inc.
- B. Underground Plastic Utilities Duct: NEMA TC 2, UL 651, ASTM F 512 Type EPC-40, with matching fittings complying with NEMA TC 3 by same manufacturer as the duct.
- C. Duct Accessories:
1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and size of ducts with which used, and selected to provide minimum duct spacing indicated while supporting ducts during concreting or backfilling.
 2. Warning Tape: Underground-line warning tape specified in Section 260553 "Identification for Electrical Systems."

2.4 PRECAST CONCRETE HANDHOLES AND BOXES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Christy Concrete Products.
 2. Oldcastle Precast, Inc.
 3. Utility Concrete Products, LLC.
- B. Comply with ASTM C 858 for design and manufacturing processes.
- C. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.
1. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 2. Configuration: Units shall be designed for flush burial.
 3. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.
 - a. Extension shall provide increased depth of 12 inches.
 - b. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.
 4. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

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2.5 HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

- A. General Requirements for Handholes and Boxes: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.
 - 1. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated.
 - 2. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
 - 3. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- B. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. Quazite: Hubbell Power Systems, Inc.
- C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with covers made of polymer concrete, reinforced concrete, cast iron, hot-dip galvanized-steel diamond plate, or fiberglass.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Carson Industries LLC.
 - b. Christy Concrete Products.
 - c. Nordic Fiberglass, Inc.
 - d. Quazite: Hubbell Power Systems, Inc.

PART 3 - EXECUTION

3.1 COORDINATION

- A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.
- B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features.
- C. Provide handholes when total bend of the duct exceeds 270 degrees and every 150' in overall length and as required by the service provider.

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3.2 PREPARATION

- A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.
- B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.
- C. Clear and grub vegetation to be removed, and protect vegetation to remain according to Section 311000 "Site Clearing." Remove and stockpile topsoil for reapplication according to Section 311000 "Site Clearing."

3.3 UNDERGROUND DUCT APPLICATION

- A. Ducts for Electrical Feeders and Branch circuits, 600 V and Less: RNC, NEMA Type EPC-40 PVC, in concrete-encased duct bank unless otherwise indicated.
- B. Underground Ducts Crossing Paved Paths, Walks, Driveways, Roadways Parking lots and Railroads: RNC, NEMA Type EPC-40-PVC, encased in reinforced concrete.

3.4 UNDERGROUND ENCLOSURE APPLICATION

- A. Handholes and Boxes for 600 V and Less:
 - 1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, with structural load rating.
 - 2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, or Fiberglass enclosures with polymer concrete frame and cover, with structural load rating.
 - 3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Fiberglass units with polymer concrete frame and cover, with structural load rating.
 - 4. Cover design load shall not exceed the design load of the handhole or box.

3.5 EARTHWORK

- A. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- B. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching.

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- C. Cut and patch existing pavement in the path of underground ducts and utility structures

3.6 DUCT INSTALLATION

- A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes, to drain in both directions.
- B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius, both horizontally and vertically, at other locations unless otherwise indicated.
- C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.
- D. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch ducts, and vary proportionately for other duct sizes.
 - 1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line.
 - 2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole. Install an expansion fitting near the center of all straight line direct-buried duct banks with calculated expansion of more than 3/4 inch.
 - 3. Grout end bells into structure walls from both sides to provide watertight entrances.
- E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet outside the building wall, without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
- F. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.
- G. Pulling Cord: Install 100-lbf- test nylon cord in empty ducts.
- H. Concrete-Encased Ducts: Support ducts on duct separators.
 - 1. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms for pipes less than 6 inches in nominal diameter.
 - 2. Depth: Install top of duct bank at least 24 inches below finished grade in areas not subject to deliberate traffic, and at least 30 inches below finished grade in deliberate traffic paths for vehicles unless otherwise indicated.
 - 3. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.

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4. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than five spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
5. Minimum Space between Ducts: 3 inches between ducts and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and signal ducts.
6. Elbows: Use manufactured duct elbows for stub-ups at poles and equipment, at building entrances through floor, and at changes of direction in duct run unless otherwise indicated. Extend concrete encasement throughout length of elbow.
7. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
8. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
9. Concrete Cover: Install a minimum of 3 inches of concrete cover at top and bottom, and a minimum of 2 inches on each side of duct bank.
10. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
 - a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
 - b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing-rod dowels extending a minimum of 18 inches into concrete on both sides of joint near corners of envelope.
11. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Section 033000 "Cast-in-Place Concrete." Place concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.

I. Direct-Buried Duct Banks:

1. Excavate trench bottom to provide firm and uniform support for duct bank. Comply with requirements in Section 312000 "Earth Moving" for preparation of trench bottoms for pipes less than 6 inches in nominal diameter.
2. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
3. Space separators close enough to prevent sagging and deforming of ducts, with not less than [four] [five] spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches between tiers.
4. Depth: Install top of ductbank at least 36 inches below finished grade unless otherwise indicated. Set elevation of bottom of ductbank below frost line.

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5. Install ducts with a minimum of 3 inches between ducts for like services and 6 inches between power and signal ducts.
6. Elbows: Install manufactured duct elbows for stub-ups at poles and equipment, at building entrances through floor, and at changes of direction in duct run unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
7. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment, at building entrances through floor, and at changes of direction in duct run.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
 - b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
8. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Section 312000 "Earth Moving" for installation of backfill materials.
 - a. Place minimum 3 inches of sand as a bed for duct bank. Place sand to a minimum of 6 inches above top level of duct bank.
 - b. Place minimum 6 inches of engineered fill above concrete encasement of duct bank.
- J. Warning Tape: Bury warning tape approximately 12 inches above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches of centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

3.7 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by manufacturer.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch above finished grade.
- D. Install handholes and boxes with bottom below frost line, below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm

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lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.

- F. Field cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
- G. For enclosures installed in asphalt paving and other surfaces subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame

3.8 GROUNDING

- A. Ground underground ducts and utility structures according to Section 260526 "Grounding and Bonding for Electrical Systems."

3.9 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
 - 1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
 - 2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 6-inch- long mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
- B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.10 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION 260543

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

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. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
 - 2. Sleeve-seal systems.
 - 3. Sleeve-seal fittings.
 - 4. Grout.
 - 5. Silicone sealants.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Wall Sleeves:
 - 1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
 - 2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.
- C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

- E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- F. Sleeves for Rectangular Openings:
 - 1. Material: Galvanized sheet steel.
 - 2. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Advance Products & Systems, Inc.
 - b. Metraflex Company (The).
 - c. Proco Products, Inc.
 - 2. Sealing Elements: Rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Connecting Bolts and Nuts of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. HOLDRITE.

2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
 - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
 - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel or cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 260544

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SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Identification for raceways.
 - 2. Identification of power and control cables.
 - 3. Identification for conductors.
 - 4. Underground-line warning tape.
 - 5. Warning labels and signs.
 - 6. Instruction signs.
 - 7. Equipment identification labels.
 - 8. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

- A. Product Data: For each electrical identification product indicated.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's

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wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and system or service type.
- C. Colors for Raceways Carrying Circuits at More Than 600 V:
 - 1. Black letters on an orange field.
 - 2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING."
- D. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- E. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- F. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- G. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4-inch- wide black stripes on 10-inch centers diagonally over orange background that extends full length of raceway or duct and is 12 inches wide. Stop stripes at legends.
- H. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
- I. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

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1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.2 METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.
- B. Colors for Cables Carrying Circuits at 600 V and Less:
 1. Black letters on an orange field.
 2. Legend: Indicate voltage and system or service type.
- C. Colors for Cables Carrying Circuits at More Than 600 V:
 1. Black letters on an orange field.
 2. Legend: "DANGER HIGH VOLTAGE WIRING."
- D. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- E. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.
- F. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.
- B. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- C. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the cable diameter such that the clear shield overlaps the entire printed legend.
- D. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.
- E. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

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- F. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.
- G. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.
- H. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the conductor diameter such that the clear shield overlaps the entire printed legend.
- C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.
- D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.
- E. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around conductor it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.
- F. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- G. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - 2. Labels for Tags: Self-adhesive label, machine-printed with permanent, waterproof, black ink recommended by printer manufacturer, sized for attachment to tag.

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2.5 FLOOR MARKING TAPE

- A. 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

2.6 UNDERGROUND-LINE WARNING TAPE

A. Tape:

- 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
- 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
- 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

- 1. Comply with ANSI Z535.1 through ANSI Z535.5.
- 2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
- 3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

C. Warning Tape:

- 1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
- 2. Overall Thickness: 5 mils.
- 3. Foil Core Thickness: 0.35 mil.
- 4. Weight: 28 lb/1000 sq. ft..
- 5. 3-Inch Tensile According to ASTM D 882: 70 lbf, and 4600 psi.

2.7 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 grommets in corners for mounting. Nominal size, 7 by 10 inches.
- D. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 10 by 14 inches.

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1. Warning labels and signs shall include, but are not limited to, the following:
 - a. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - b. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES"
 - c. Arc Flash Hazard Warning: Refer to Section 260574 for requirements.

2.8 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.
 1. Engraved legend with black letters on white face.
 2. Punched or drilled for mechanical fasteners.
 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
- B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

2.9 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.10 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
 1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
 3. Temperature Range: Minus 40 to plus 185 deg F.
 4. Color: Black except where used for color-coding.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.
 1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
 3. Temperature Range: Minus 40 to plus 185 deg F.
 4. Color: Black.
- C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.
 1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
 3. UL 94 Flame Rating: 94V-0.

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- 4. Temperature Range: Minus 50 to plus 284 deg F.
- 5. Color: Black.

2.11 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- G. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
 - 1. Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.
- I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
- J. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

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3.2 IDENTIFICATION SCHEDULE

- A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label. Install labels at 10-foot maximum intervals.
- B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
 - 1. Emergency Power.
 - 2. Power.
 - 3. UPS.
- C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
 - 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
 - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
 - b. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - 4) Grounded (Neutral): White.
 - 5) Ground: Green.
 - c. Colors for 480/277-V Circuits:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - 4) Grounded (Neutral): Gray.
 - 5) Ground: Green.
 - d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- D. Power-Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic plastic tag holder with adhesive-backed phase tags, and a separate tag with the circuit designation.
- E. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

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- F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive, self-laminating polyester labels with the conductor or cable designation, origin, and destination.
- G. Control-Circuit Conductor Termination Identification: For identification at terminations provide heat-shrink preprinted tubes or self-adhesive, self-laminating polyester labels with the conductor designation.
- H. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.
- I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- J. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
 - 1. Limit use of underground-line warning tape to direct-buried cables.
 - 2. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- K. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- L. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
 - 1. Comply with 29 CFR 1910.145.
 - 2. Identify system voltage with black letters on an orange background.
 - 3. Apply to exterior of door, cover, or other access.
 - 4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
- M. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- N. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer and load shedding.

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- O. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:
 - a. Indoor Equipment: Adhesive film label with clear protective overlay. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
 - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
 2. Equipment to Be Labeled:
 - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be, laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Switchboards.
 - e. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
 - f. Emergency system boxes and enclosures.
 - g. Enclosed switches.
 - h. Enclosed circuit breakers.
 - i. Enclosed controllers.
 - j. Variable-speed controllers.
 - k. Push-button stations.
 - l. Power transfer equipment.
 - m. Contactors.
 - n. Remote-controlled switches, dimmer modules, and control devices.
 - o. Battery-inverter units.
 - p. Power-generating units.
 - q. Monitoring and control equipment.
 - r. UPS equipment.

END OF SECTION 260553

SECTION 260572 - OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY

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.
- B. This study and its results may be performed in conjunction with those in SECTION 260573 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY and/or SECTION 260574 - OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY. Provide a clearly defined separate Executive summary for each specification section. Provide the combined study submittal labeled as "SECTION 260572"

1.2 SUMMARY

- A. Section includes a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices.
 - 1. All revisions required to the study upon receiving recommendations and incorporating associated plan revisions shall be included at no additional cost.

1.3 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- D. SCCR: Short-circuit current rating.
- E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 ACTION SUBMITTALS

- A. Product Data: For computer software program to be used for studies.

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- B. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals may be in digital form.
1. Short-circuit study input data, including completed computer program input data sheets.
 2. Short-circuit study and equipment evaluation report; signed and dated
 - a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.
 - b. Revised single-line diagram, reflecting field investigation results and results of short-circuit study.

1.5 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

PART 2 - PRODUCTS

2.1 SHORT-CIRCUIT STUDY REPORT CONTENTS

- A. Executive summary listing the major deficiencies and recommend remedy or remediation
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of the computer printout.
- C. One-line diagram, showing the following:
1. Protective device designations and ampere ratings.
 2. Cable size and lengths.
 3. Transformer kilovolt ampere (kVA) and voltage ratings.
 4. Motor and generator designations and kVA ratings.
 5. Switchgear, switchboard, motor-control center, and panelboard designations.
- D. Comments and recommendations for system improvements, where needed.
- E. Protective Device Evaluation:
1. Evaluate equipment and protective devices and compare to short-circuit ratings.
 2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
 3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
 4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.

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5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
- F. Short-Circuit Study Input Data: As described in "Power System Data" Article in the Evaluations.
- G. Short-Circuit Study Output:
1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. Equivalent impedance.
 2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. Calculated asymmetrical fault currents:
 - 1) Based on fault-point X/R ratio.
 - 2) Based on calculated symmetrical value multiplied by 1.6.
 - 3) Based on calculated symmetrical value multiplied by 2.7.
 3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. No AC Decrement (NACD) ratio.
 - e. Equivalent impedance.
 - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
 - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Obtain all data necessary for the conduct of the study.

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1. Verify completeness of data supplied on the one-line diagram. Call any discrepancies to the attention of Architect.
 2. For equipment provided that is Work of this Project, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
 3. For **relocated** equipment **and** that **which** is existing to remain, obtain required electrical distribution system data by field investigation and surveys.
- B. Gather and tabulate the following input data to support the short-circuit study. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field.
1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 2. Obtain electrical power utility impedance at the service.
 3. Power sources and ties.
 4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
 5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
 6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
 7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
 8. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
 9. Motor horsepower and NEMA MG 1 code letter designation.
 10. Cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

3.2 SHORT-CIRCUIT STUDY

- A. Perform study following the general study procedures contained in IEEE 399.
- B. Calculate short-circuit currents according to IEEE 551.
- C. Base study on the device characteristics supplied by device manufacturer.
- D. The extent of the electrical power system to be studied is indicated on Drawings.
- E. Begin short-circuit current analysis at the service, extending down to the system overcurrent protective devices as follows:
 1. To normal system low-voltage load buses where fault current is 10 kA or less.
- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

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- G. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.
 - 1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.
- H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each of the following:
 - 1. Electric utility's supply termination point.
 - 2. Incoming switchgear.
 - 3. Unit substation primary and secondary terminals.
 - 4. Low-voltage switchgear.
 - 5. Motor-control centers.
 - 6. Control panels.
 - 7. Standby generators and automatic transfer switches.
 - 8. Branch circuit panelboards.
 - 9. Disconnect switches.

3.3 ADJUSTING

- A. Make minor modifications to equipment as required to accomplish compliance with short-circuit study.

3.4 RELEASE OF ELECTRICAL EQUIPMENT

- A. The electrical equipment that is part of this study may not be released for manufacturing until this report is submitted to and approved by the Architect.

END OF SECTION 260572

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SECTION 260573 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

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.
- B. This study and its results may be performed in conjunction with those in SECTION 260572 - OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY and/or SECTION 260574 - OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY. Provide a clearly defined separate Executive summary for each specification section. Provide the combined study submittal labeled as "SECTION 260572"

1.2 SUMMARY

- A. Section includes computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.
 - 1. Study results shall be used to determine coordination of series-rated devices.
 - 2. All revisions required to the study upon receiving recommendations and incorporating associated plan revisions shall be included at no additional cost.

1.3 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- D. SCCR: Short-circuit current rating.
- E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

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1.4 ACTION SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals may be in digital form.
 - 1. Coordination-study input data, including completed computer program input data sheets.
 - 2. Study and equipment evaluation reports.
 - 3. Overcurrent protective device coordination study report; signed, dated, and sealed by a qualified professional engineer.
 - a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.5 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

PART 2 - PRODUCTS

2.1 PROTECTIVE DEVICE COORDINATION STUDY REPORT CONTENTS

- A. Executive summary listing the major deficiencies and recommend remedy or remediation
- B. Study descriptions, purpose, basis and scope. Include case descriptions, definition of terms and guide for interpretation of the computer printout.
- C. One-line diagram, showing the following:
 - 1. Protective device designations and ampere ratings.
 - 2. Cable size and lengths.
 - 3. Transformer kilovolt ampere (kVA) and voltage ratings.
 - 4. Motor and generator designations and kVA ratings.
 - 5. Switchgear, switchboard, motor-control center, and panelboard designations.
- D. Study Input Data: As described in "Power System Data" Article.
- E. Short-Circuit Study Output: As specified in "Short-Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."
- F. Protective Device Coordination Study:

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1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.
 - a. Phase and Ground Relays:
 - 1) Device tag.
 - 2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
 - 3) Recommendations on improved relaying systems, if applicable.
 - b. Circuit Breakers:
 - 1) Adjustable pickups and time delays (long time, short time, ground).
 - 2) Adjustable time-current characteristic.
 - 3) Adjustable instantaneous pickup.
 - 4) Recommendations on improved trip systems, if applicable.
 - c. Fuses: Show current rating, voltage, and class.
- G. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
 1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
 2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
 3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
 4. Plot the following listed characteristic curves, as applicable:
 - a. Power utility's overcurrent protective device.
 - b. Medium-voltage equipment overcurrent relays.
 - c. Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
 - d. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
 - e. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
 - f. Cables and conductors damage curves.
 - g. Ground-fault protective devices.
 - h. Motor-starting characteristics and motor damage points.
 - i. Generator short-circuit decrement curve and generator damage point.
 - j. The largest feeder circuit breaker in each motor-control center and panelboard.
 5. Series rating on equipment allows the application of two series interrupting devices for a condition where the available fault current is greater than the interrupting rating of the

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downstream equipment. Both devices share in the interruption of the fault and selectivity is sacrificed at high fault levels. Maintain selectivity for tripping currents caused by overloads.

6. Provide adequate time margins between device characteristics such that selective operation is achieved.
7. Comments and recommendations for system improvements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.
 1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 PROTECTIVE DEVICE COORDINATION STUDY

- A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.
- B. Comply with IEEE 399 for general study procedures.
- C. The study shall be based on the device characteristics supplied by device manufacturer.
- D. The extent of the electrical power system to be studied is indicated on Drawings.
- E. Begin analysis at the service, extending down to the system overcurrent protective devices as follows:
 1. To normal system low-voltage load buses where fault current is 10 kA or less.
- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- G. Transformer Primary Overcurrent Protective Devices:
 1. Device shall not operate in response to the following:
 - a. Inrush current when first energized.
 - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
 - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.

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2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

H. Motor Protection:

1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.
2. Select protection for motors served at voltages more than 600 V according to IEEE 620.

I. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

J. Generator Protection: Select protection according to manufacturer's written recommendations and to IEEE 242.

K. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.

1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

L. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and single line-to-ground fault at each of the following:

1. Electric utility's supply termination point.
2. Switchgear.
3. Unit substation primary and secondary terminals.
4. Low-voltage switchgear.
5. Motor-control centers.
6. Standby generators and automatic transfer switches.
7. Branch circuit panelboards.

M. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.
2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.

3.3 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the overcurrent protective device study.

1. Verify completeness of data supplied in the one-line diagram on Drawings. Call discrepancies to the attention of Architect.

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2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
 3. For existing equipment, whether or not relocated obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. The qualifications of technicians and engineers shall be qualified as defined by NFPA 70E.
- B. Gather and tabulate the following input data to support coordination study. The list below is a guide. Comply with recommendations in IEEE 551 for the amount of detail required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 2. Electrical power utility impedance at the service.
 3. Power sources and ties.
 4. Short-circuit current at each system bus, three phase and line-to-ground.
 5. Full-load current of all loads.
 6. Voltage level at each bus.
 7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
 8. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
 9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
 10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
 11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
 12. Maximum demands from service meters.
 13. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
 14. Motor horsepower and NEMA MG 1 code letter designation.
 15. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
 16. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.
 17. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
 - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
 - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.

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- c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
- d. Generator thermal-damage curve.
- e. Ratings, types, and settings of utility company's overcurrent protective devices.
- f. Special overcurrent protective device settings or types stipulated by utility company.
- g. Time-current-characteristic curves of devices indicated to be coordinated.
- h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
- i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
- j. Panelboards, switchboards, motor-control center ampacity, and SCCR in amperes rms symmetrical.
- k. Identify series-rated interrupting devices for a condition where the available fault current is greater than the interrupting rating of the downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.

3.4 FIELD ADJUSTING

- A. Adjust relay and protective device settings according to the recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.
- B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.
- C. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters. Perform NETA tests and inspections for all adjustable overcurrent protective devices.

3.5 RELEASE OF ELECTRICAL EQUIPMENT

- A. The electrical equipment that is part of this study may not be released for manufacturing until this report is submitted to and approved by the Architect.

END OF SECTION 260573

SECTION 260574 - OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY

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.
- B. This study and its results may be performed in conjunction with those in SECTION 260572 - OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY and/or SECTION 260573 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY. Provide a clearly defined separate Executive summary for each specification section. Provide the combined study submittal labeled as "SECTION 260572"

1.2 SUMMARY

- A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.
 - 1. All revisions required to the study upon receiving recommendations and incorporating associated plan revisions shall be included at no additional cost.

1.3 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- D. SCCR: Short-circuit current rating.
- E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 ACTION SUBMITTALS

- A. Product Data: For computer software program to be used for studies.

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- B. Other Action Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals may be in digital form.
 - 1. Arc-flash study input data, including completed computer program input data sheets.
 - a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.5 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

PART 2 - PRODUCTS

2.1 ARC-FLASH STUDY REPORT CONTENT

- A. Executive summary listing the major deficiencies and recommend remedy or
- B. Study descriptions, purpose, basis and scope.
- C. One-line diagram, showing the following:
 - 1. Protective device designations and ampere ratings.
 - 2. Cable size and lengths.
 - 3. Transformer kilovolt ampere (kVA) and voltage ratings.
 - 4. Motor and generator designations and kVA ratings.
 - 5. Switchgear, switchboard, motor-control center and panelboard designations.
- D. Study Input Data: As described in "Power System Data" Article.
- E. Arc-Flash Study Output:
 - 1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. No AC Decrement (NACD) ratio.
 - e. Equivalent impedance.
 - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
 - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

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F. Incident Energy and Flash Protection Boundary Calculations:

1. Arcing fault magnitude.
2. Protective device clearing time.
3. Duration of arc.
4. Arc-flash boundary.
5. Working distance.
6. Incident energy.
7. Hazard risk category.
8. Recommendations for arc-flash energy reduction.

G. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

2.2 ARC-FLASH WARNING LABELS

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems." Produce a 3.5-by-5-inch thermal transfer label of high-adhesion polyester for each work location included in the analysis.
- B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
1. Location designation.
 2. Nominal voltage.
 3. Flash protection boundary.
 4. Hazard risk category.
 5. Incident energy.
 6. Working distance.
 7. Engineering report number, revision number, and issue date.
- C. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 ARC-FLASH HAZARD ANALYSIS

- A. Comply with NFPA 70E and its Annex D for hazard analysis study.
- B. Calculate maximum and minimum contributions of fault-current size.

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1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.
 2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
- C. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.
- D. Include medium- and low-voltage equipment locations, except equipment rated 240-V ac or less fed from transformers less than 125 kVA.
- E. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.
- F. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:
1. Fault contribution from induction motors should not be considered beyond three to five cycles.
 2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).
- G. Arc-flash computation shall include both line and load side of a circuit breaker as follows:
1. When the circuit breaker is in a separate enclosure.
 2. When the line terminals of the circuit breaker are separate from the work location.
- H. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.3 POWER SYSTEM DATA

- A. Obtain all data necessary for the conduct of the arc-flash hazard analysis.
1. Verify completeness of data supplied on the one-line diagram on Drawings. Call discrepancies to the attention of Architect.
 2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
 3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys,.
- B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field.

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1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility impedance at the service.
3. Power sources and ties.
4. Short-circuit current at each system bus, three phase and line-to-ground.
5. Full-load current of all loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in per cent, and phase shift.
8. For reactors, provide manufacturer and model designation, voltage rating and impedance.
9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
13. Motor horsepower and NEMA MG 1 code letter designation.
14. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
15. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.

3.4 LABELING

- A. Apply one arc-flash label for 600-V ac, 480-V ac, and applicable 208-V ac panelboards and disconnects and for each of the following locations:
 1. Motor-control center.
 2. Low-voltage switchboard
 3. Panelboards.

3.5 APPLICATION OF WARNING LABELS

- A. Install the arc-fault warning labels under the direct supervision and control of the Arc-Flash Study Specialist.

3.6 RELEASE OF ELECTRICAL EQUIPMENT

- A. The electrical equipment that is part of this study may not be released for manufacturing until this report is submitted to and approved by the Architect.

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END OF SECTION 260574

SECTION 260813 - COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. The purpose of this section is to specify Division 26 contractor responsibilities in the commissioning (Cx) process.
- B. Commissioning requires the participation of the Division 26 contractor to ensure that all systems are operating in a manner consistent with the Contract Documents. The general commissioning requirements and coordination are detailed in Section 019113, General Commissioning Requirements. The Division 26 contractor shall be familiar with all parts of Section 019113 and the Cx Plan issued by the Commissioning Authority (CxA) and shall execute all commissioning responsibilities assigned to them in the Contract Documents.
- C. Section includes Cx process requirements for the following electrical systems, assemblies, and equipment:
 - 1. Emergency Generator
 - 2. Automatic Transfer Switches
 - 3. Fire Alarm System limited to interface with the Mechanical System
 - 4. Room lighting controls including occupancy/daylight sensor and wall switches

1.3 RESPONSIBILITIES

- A. The responsibilities of various parties in the commissioning process, as specifically related to the electrical systems, are provided in this section.
- B. Refer to Section 019113 and the Cx Plan for all typical commissioning process requirements for each team member.
- C. Refer to Section 019113 for smoke control system commissioning, testing, and inspection requirements.
- D. Each Contractor and subcontractor shall review this Section and shall include in their bids cost for carrying out the work described, as it applies to each Division and Section of these specifications, individually and collectively.
- E. The commissioning responsibilities applicable to the contractors of Division 26 are as follows (all references apply to commissioned equipment only):

Construction and Acceptance Phases

1. Include the cost of commissioning work in the contract price
2. Attend a commissioning kick-off meeting and other meetings scheduled by the CxA as necessary to facilitate the Cx process, as indicated in specification section 019113.
3. Contractors shall provide the CxA with cut sheets and shop drawing submittals of commissioned equipment.
4. Provide additional requested documentation, prior to O&M manual submittals, to the CxA for development of Pre-Functional Checklists (PFC) and Functional Performance Testing (FPT) procedures.
 - a. This will include detailed manufacturer installation and startup, operating, troubleshooting and maintenance procedures, full details of any owner-contracted tests, full factory testing reports, if any, and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation and checkout materials that are 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 CxA.
 - b. The CxA may request further documentation necessary for the commissioning process.
 - c. This data request may be made prior to normal submittals.
5. Provide a copy of the equipment submittals of commissioned equipment, through normal channels, to the CxA for review and comment.
6. Contractors shall assist (along with the design engineers) 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.
7. Provide assistance to the CxA in preparing the specific FPT procedures specified in the Cx Plan (prepared by the CxA), Section 019113 and this section. Contractor shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.
8. Develop a full startup and initial checkout plan using manufacturer's startup procedures and the PFCs from the CxA. Submit manufacturer's detailed startup procedures and the full startup plan and procedures and other requested equipment documentation to CxA for review and comment prior to startup. Refer to Section 019113 for further details on startup plan preparation.
9. During the startup and initial checkout process, execute and document the electrical-related portions of the PFCs provided by the CxA for all commissioned equipment.
10. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the CxA.
11. Address current A/E punch list items before functional performance testing.
12. Provide skilled technicians to execute starting of equipment and to execute the FPTs. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.
13. Perform FPT under the direction of the CxA for specified equipment the Cx Plan, Section 019113 and this Section. Assist the CxA in interpreting the monitoring data, as necessary.
14. Correct deficiencies as indicated by the CxA and directed by the OPM and/or A/E and retest the equipment.
15. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.

16. During construction, maintain as-built/record red-line drawings and CAD drawings and provide final record drawings for contractor-generated coordination drawings. Update after completion of commissioning (excluding deferred testing).
17. Provide training of the Owner's operating personnel using expert qualified personnel, as specified.
18. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

Warranty Period

1. Execute seasonal or deferred functional performance testing, witnessed by the CxA, according to the specifications.
2. Correct deficiencies and make necessary adjustments to O&M manuals and record drawings for applicable issues identified in any seasonal testing.
3. Participate in the near-warranty end (ten month) post occupancy visit.

1.4 RELATED WORK

- A. Refer to Section 019113 for a listing of all sections where commissioning requirements are found.
- B. Refer to Section 019113 for systems to be commissioned.

1.5 SUBMITTALS

- A. Division 26 shall provide submittal documentation relative to commissioning to the CxA as requested by the CxA. Refer to Section 019113 for additional Division 26 requirements.

1.6 WEB-BASED COMMISSIONING PORTAL

- A. All general and major contractors participating in the Cx process shall use the web-based Cx Portal, CxAlloy ("Portal" or "CxAlloy") to document the Cx procedures. The Portal is a Web-based Internet hub used to electronically collaborate and coordinate activities and deliverables throughout the Cx process. The Portal is hosted by the CxA and shall be accessible to all Parties participating in the Cx program. The Portal provides a common location to store PFCs, Startup Documentation, FPTs and results, Issues Log tracking, project documents and deliverables. It also serves as a collaborative e-mail hub to facilitate, automate, and track communications between Parties relating to the Cx process.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. The Division 26 contractor shall provide all test equipment necessary to fulfill the testing requirements of this Division 26 systems and equipment.
- B. Refer to Section 019113 for additional Division 26 requirements.

- C. Proprietary test equipment required by the manufacturer, whether specified or not, shall be provided by the manufacturer of the equipment through the contractor. The manufacturer shall provide the test equipment, demonstrate its use and assist the CxA in the Cx process.

2.2 INCIDENTAL EQUIPMENT

- A. The Division 26 contractor shall provide all scaffolds, staging, ladders and accessories required to allow testing agencies, consultants and Owner's staff safe access to equipment, electrical boxes and other devices located above floor level.

PART 3 - EXECUTION

3.1 MEETINGS

- A. Refer to Section 019113 for additional meeting requirements.
- B. Participation at various commissioning meetings shall depend on the purpose of the meeting and may consist of, but not be limited to, the following members of the project commissioning team: the Owner's representative (i.e. project manager and/or facility staff), the CxA, the CM/GC, subcontractors and/or manufacturer's technical representative as required, the architect/engineer (A/E), and any specialists deemed appropriate by the Cx team.
- C. All the listed Cx team members shall participate in the Cx kick-off meeting.
- D. Participate, as applicable, in Cx coordination meetings in accordance with related Section 019113.
- E. Participate, as needed, in deficiency resolution meetings.

3.2 STARTUP

- A. The electrical contractor shall follow the startup, initial checkout procedures, and PFCs listed in the Responsibilities list in this section and Section 019113. The Division 26 contractor has startup responsibility and is required to complete systems and sub-systems so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the CxA or Owner.
- B. FPT is intended to begin upon completion of a system. FPT will not proceed prior to the completion of systems, or sub-systems, which includes completion of the PFCs and completion and approval of any necessary testing requirements.

3.3 PRE-FUNCTIONAL CHECKLISTS

- A. Sampling Strategy: 100% of systems and equipment shall have PFCs completed and submitted for review and approval prior to functional performance testing. The CxA may observe the Contractor's completion of the PFCs.
- B. Typical aspects of electrical PFCs verify that the equipment matches the approved submittal, is installed properly, is started-up (and startup is documented) and integrated disciplines (i.e. electrical, equipment vendors, controls) have completed their work required for the equipment

and system to function in its entirety. Examples would include spot checking of wiring/termination point-to-points and verification of alarm point parameters and messages.

3.4 TESTING PREPARATION

- A. Inspect and verify the position of each device and interlock identified on checklists.
- B. Certify that electrical systems, subsystems, and equipment have been installed, calibrated, started, quality control tested, and code tested (as applicable) and are operating according to the Contract Documents.
- C. Certify that electrical instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest setpoints have been recorded.

3.5 FUNCTIONAL PERFORMANCE TESTS

- A. FPT is intended to begin upon completion of a system, including startup and completion of the PFCs. Functional testing may proceed prior to the completion of systems or sub-systems at the discretion of the CxA and Owner. Beginning system testing before full completion does not relieve the Contractor from fully completing the system, including all PFCs as soon as possible.
- B. Refer to Section 019113 for a description of the process.
- C. Sampling Strategy
 - 1. Emergency generator (100%)
 - 2. Automatic transfer switches (100%)
 - 3. Fire Alarm System (limited to interface with the mechanical System)
 - 4. Occupancy/daylight sensor and wall switches (20%)
- D. Refer to Section 011913, Sampling for the Sampling/Failure Rate.
- E. Typical aspects of electrical FPTs verify that systems, subsystems and equipment function interactively and throughout the full range of operating conditions (e.g. low load, design load, component failures, alarm conditions, safety interlocks including with life safety systems, etc.) and modes (e.g. normal shutdown, normal auto position, normal manual position, power failure including control power, emergency power, unoccupied, fire alarm, 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. Positive confirmation of state/status shall be shown both locally and via the BAS, as specified in the Contract Documents.
- F. Development of Test Procedures: Before test procedures are written, the CxA shall obtain project contract documentation and a current list of change orders and RFI's affecting equipment or systems, including an updated points list, program code, control sequences and parameters and electrical coordination study. The CxA shall develop specific test procedures and forms for evaluating performance of all integral components and their functioning as a complete unit within design requirements and manufacturer's published data. Prior to execution, the CxA shall provide a copy of the test procedures to the Contractors who shall review the tests for feasibility, safety, equipment and warranty protection.

3.6 TESTING DOCUMENTATION, NON-CONFORMANCE AND ACCEPTANCE

- A. Refer to Section 019113 for specific details on non-conformance issues relating to PFCs and tests.
- B. Refer to Section 019113 for issues relating to functional performance tests.

3.7 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. The following O&M manual requirements do not replace O&M manual documentation requirements elsewhere in the Contract Documents.
- B. The Division 26 shall compile and prepare documentation for all equipment and systems covered in Division 26 and deliver this documentation to the CM/GC for inclusion in the O&M manuals.
- C. The CxA shall receive a copy of the O&M manuals for concurrent review and comment with the A/E.

3.8 TRAINING OF OWNER PERSONNEL

- A. The CM/GC shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed in accordance with Division 1 requirements. Refer to Section 019113 for additional details.
- B. The CxA shall be responsible for reviewing and providing comments for the adequacy of the training of Owner personnel for commissioned equipment. Refer to Section 019113 for additional details.
- C. Electrical Contractor: The electrical contractor shall have the following training responsibilities:
 - 1. Provide the CxA with a training plan eight (8) weeks before the planned training according to the outline described in Section 019113.
 - 2. Provide designated Owner personnel with comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of commissioned electrical equipment or system.
 - 3. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual, the system will be repaired or adjusted as necessary and the demonstration repeated.
 - 4. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the startup technician for the piece of equipment, the installing contractor or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.
 - 5. The training sessions shall follow the outline in the Table of Contents of the O&M manual and illustrate whenever possible the use of the O&M manuals for reference.
 - 6. Training shall include:
 - a. Use of the printed installation, operation and maintenance instruction material included in the O&M manuals.
 - b. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventive maintenance, special tools needed and spare parts

inventory suggestions. The training shall include startup, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.

- c. Discussion relevant health and safety issues and concerns.
 - d. Discussion warranties and guarantees.
 - e. Common troubleshooting problems and solutions.
 - f. Explanatory information included in the O&M manuals and the location of all plans and manuals in the facility.
 - g. Discussion of any peculiarities of equipment installation or operation.
- 7. Hands-on training shall include startup, operation in all modes possible, including manual, shutdown and any emergency procedures and preventative maintenance of all pieces of equipment.
 - 8. The electrical contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not controlled by the central control system.
 - 9. Training shall occur after functional testing is complete, unless approved otherwise by the Owners.

3.9 DEFERRED TESTING

- A. Refer to Section 019113 for requirements of deferred testing.

3.10 WRITTEN WORK PRODUCTS

- A. Written work products of Contractors will consist of the startup and initial checkout plan described in Section 019113 and the completed startup, initial checkout and PFCs.

END OF SECTION 260813

SECTION 260923.1 - LIGHTING CONTROLS

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 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
 - 1. Interconnection diagrams showing field-installed wiring.
 - 2. Include diagrams for power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

1.4 COORDINATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

1.5 WARRANTY

- A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of lighting controls that fail in materials or workmanship or from transient voltage surges, and the Contractor agrees to provide associated electrical work to make good within the specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure equipment to operate, or to operate reliably.
 - b. Damage of electronic components due to transient voltage surges.
 - 2. Warranty Period: One year from date of Final Acceptance for material and labor.
 - 3. Extended Material Warranty Period Failure Due to Transient Voltage Surges: 10 years from date of Final Acceptance.

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PART 2 - PRODUCTS

2.1 INDOOR OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Hubbell Building Automation, Inc.
 2. Leviton Manufacturing Co., Inc.
 3. Acuity Brands Lighting, Inc.
 4. Lutron Electronics Co., Inc.
 5. Sensorworx.
 6. Watt Stopper.
 7. Cooper Lighting Solutions.
- B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
 4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
 5. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
 7. When daylighting is indicated on the drawings, provide Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.
- C. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average

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size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.

3. Detection Coverage:
 - a. **Standard Height Units:** In areas that have ceiling heights of 12 feet or lower, provide Watt Stopper unit DT-300 (or approved equal): Detect occupancy anywhere within a circular area up to 2000 square feet. Detectors shall be networkable to allow coverage of larger or irregularly shaped areas.
 - b. **High Ceiling Units:** In areas that have ceiling/mounting height over 12 feet up to 40 foot mounting including but not limited to Gymnasium, Auditorium, Cafeteria (commons) and forum spaces, provide Watt Stopper unit HB3x0 with L4 lens, or approved equal. Detect occupancy anywhere within a circular area up to 3500 square feet. Detectors shall be networkable to allow coverage of larger or irregularly shaped areas.

2.2 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. [Hubbell Building Automation, Inc.](#)
 2. [Leviton Manufacturing Co., Inc.](#)
 3. [Acuity Brands Lighting, Inc.](#)
 4. [Lutron Electronics Co., Inc.](#)
 5. Sensorworx.
 6. [Watt Stopper.](#)
 7. [Cooper Lighting Solutions.](#)
- B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.
 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
 3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.
- C. Wall-Switch Sensor:
 1. Standard Range: 180-degree field of view; with a minimum coverage area of 1000 sq. ft.
 2. Sensing Technology: Dual technology.
 3. Voltage: Dual voltage, 120 and 277 V.
 4. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
 5. Concealed "off" time-delay selector at 30 seconds, and 5, 10, and 20 minutes.
 6. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

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2.3 EMERGENCY SHUNT RELAY

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Acuity Brands Lighting, Inc.
 2. Watt Stopper.
 3. Bodine
 4. Functional Devices
 5. LVS
 6. Myers
- B. Description: Normally closed, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 924.
1. Coil Rating: 277 V.

2.4 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 CONTACTOR INSTALLATION

- A. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

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3.3 WIRING INSTALLATION

- A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Lighting control devices will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within months from date of Final Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to **two** visits to Project during other-than-normal occupancy hours for this purpose.

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

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SECTION 262200 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUBMITTALS

- A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.
- B. Percent Impedance for each transformer type.
- C. 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. Wiring Diagrams: Power, signal, and control wiring.
- D. Source quality-control test reports.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain each transformer type through one source from a single manufacturer.

1.4 COORDINATION

- A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include limited to the following:
1. Eaton Electrical Inc.; Cutler-Hammer Products.
 2. General Electric Company.
 3. Siemens Energy & Automation, Inc.
 4. Square D; Schneider Electric. (Basis of Design)

2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Cores: Grain-oriented, non-aging silicon steel.
- C. Coils: Continuous windings without splices except for taps.
1. Internal Coil Connections: Brazed or pressure type.
 2. Coil Material: Aluminum or Copper.

2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NEMA ST 20, and list and label as complying with UL 1561.
- B. Cores: One leg per phase.
- C. Indoor Transformers
1. Enclosure: Ventilated, NEMA 250, Type 2.
 - a. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
- D. Outdoor Transformers
1. Enclosure: Totally enclosed, nonventilated.
 2. NEMA 250, Type 3R: Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
- E. Transformer Enclosure Finish: Manufacturer's standard color. Comply with NEMA 250.
- F. Taps for Transformers Smaller Than 3 kVA: None.
- G. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.

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- H. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.
- I. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.
- J. Energy Efficiency for Transformers Rated 15 kVA and Larger:
 - 1. Minimum transformer efficiencies must satisfy efficiencies promulgated within United States Code of Federal Regulations CFR Title 10 Chapter II Part 431 (Appendix A of Subpart K 2016); these efficiency levels are commonly referred to as the "DOE 2016 Efficiency.
- K. Wall Brackets: Manufacturer's standard brackets.
- L. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

2.4 IDENTIFICATION DEVICES

- A. Nameplates: Engraved, laminated-plastic or metal nameplate for each transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.

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- B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions.

3.3 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- C. Remove and replace units that do not pass tests or inspections and retest as specified above.
- D. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

3.7 WARRANTY

- A. Warranty Period: Provide a warranty to repair or replace for One year from date of Final Acceptance.

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SECTION 262416 - PANELBOARDS

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. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

- A. SVR: Suppressed voltage rating.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 6. Provide a coordination drawing of each electrical room or space contain electrical equipment using the actual dimensions of the equipment to be supplied indicating clearances and equipment dimensions.
- C. Field Quality-Control Reports:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.

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3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
 - D. Operation and Maintenance Data: For panelboards and components 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. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.
 - E. Coordination Study Report: The findings of the Section 260573 Coordination Study Report (CSR) may affect the overcurrent protective devices and fault-current withstand requirements for switchboards, panelboards, and transfer switches. Also, the preparation of the CSR is dependent on the manufacturer's data for this equipment. Therefore until Submittal final Approval is granted for the CSR, these materials shall be considered at best "Approved, pending Approval of the CSR" and not released for order.
- 1.5 QUALITY ASSURANCE
- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
 - B. Comply with NFPA 70.
- 1.6 PROJECT CONDITIONS
- A. Environmental Limitations:
 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding minus 22 deg F (minus 30 deg C) to plus 104 deg F (plus 40 deg C).
 - b. Altitude: Not exceeding 6600 feet (2000 m).
 - B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 1. Ambient temperatures within limits specified.
 2. Altitude not exceeding 6600 feet (2000 m).

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1.7 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.8 WARRANTY

- A. Manufacturer's standard form in which manufacturer agrees to repair or replace equipment that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: One year from date of Final Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Enclosures:
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Locations: NEMA 250, Type 1.
 - b. Exterior Locations: NEMA 250, Type 4X
 - c. Kitchen and areas subject to water and corrosion: NEMA 250, Type 4X
 - 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 - 3. Finishes:
 - a. Panels and Trim: galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Same finish as panels and trim.
 - 4. Directory Card: Inside panelboard door, mounted in transparent card holder, with metal frame.
- B. Incoming Mains Location: Top or bottom.
- C. Phase, Neutral, and Ground Buses:
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- D. Conductor Connectors: Suitable for use with conductor material and sizes.

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1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Main and Neutral Lugs: Mechanical type.
 3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
- E. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- F. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.
- G. All branch breakers over 60A in panelboards on the life safety, legally required and optional standby systems shall have LSI (long time, short time and instantaneous) settings. All main breakers in panelboards on the life safety, legally required and optional standby systems shall be LI mission critical breakers. Upsize the breaker frame size as required.
- H. All panelboards on the life safety branch shall be provided with either integral or external surge protection devices. Provide associated OCPD, wiring, and necessary equipment per manufacturer's requirements.

2.2 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work limited to the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric. (Basis of design)
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.
- D. Mains: Circuit breaker.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include limited to the following:

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1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric. (Basis of Design)
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker.
- D. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
1. 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.
 2. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
- C. Arc Energy Reduction. Where the highest continuous current trip setting of a circuit breaker is rated or can be adjusted to is 1200 A or higher.
1. Provide one of the following methods to reduce clearing time
 - a. Zone-selective interlocking
 - b. Differential relaying
 - c. Energy-reducing maintenance switching with local status indicator
 - d. Energy-reducing active arc flash mitigation system
 2. Indicate the method of compliance in the submittals

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3. Provide documentation how the breaker is authorized to be installed, operated, and/or inspected
4. Contractor shall adhere to the documentation and post the information at the location of the circuit breaker(s).

2.5 MINI UNIT SUBSTATIONS

- A. UL Listed and tested assembly consisting of
 1. Primary and Secondary Main Circuit Breaker
 - a. Circuit breaker ratings are selected to meet National Electrical Code (NEC) requirements and to coordinate with transformer magnetizing inrush current
 2. Sealed Step-Down Transformer
 - a. 185°C (365°F) insulation with 115°C (239°F) temperature rise
 - b. Sealed, epoxy-resin encapsulated transformer
 3. Distribution Panelboard
 - a. Panel section has copper bus and uses standard circuit breakers. Tandem breakers are not allowed.
 - b. Feeder circuit breakers are standard plug-on type

2.6 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Each panelboard section shall not exceed 42 single poles.
- C. Panelboards 400A and less shall not exceed 20 in. (508 mm) wide by 5.75 in. (223 mm) deep

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.

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- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- C. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.
- D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- E. Install overcurrent protective devices and controllers not already factory installed.
- F. Install filler plates in unused spaces.
- G. Arrange conductors in gutters into groups and bundle and wrap with wire ties.
- H. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. This includes thermo graphic survey. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Panelboards will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports, including a report that identifies panelboards included and that describes scanning results. Include IR color photos of each panel scanned. For panels with

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defects found, include "before" and "after" defect is repaired. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 262416

SECTION 262550 – GENERATOR DOCKING STATIONS

PART 1 - GENERAL

1.1. 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. ETL/UL LISTED
- C. UL 50 LISTED

1.2. COORDINATION

- A. Coordinate layout and installation of Generator Docking Station, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels

1.3. GUARANTEE/WARRANTY

- A. Manufacturer Warranty shall be provided for a minimum of 1 Year,
 - 1. Extended Warranty will be supplied upon at user's request at an additional charge from Manufacturer.
- B. The equipment installed under this contract shall be left in proper working order
- C. New materials and equipment shall be guaranteed against defects in composition, design or workmanship. Guarantee certificates shall be furnished.

PART 2 - PRODUCTS

2.1. DOCKING STATION

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Basis of Design - TRYSTAR: Dual Purpose Docking Station DBDS-5
 - 2. Asco
 - 3. Eaton

2.2. GENERAL REQUIREMENTS

- A. Enclosure

1. NEMA 4X Enclosure
 - i. Pad-lockable front door shall include a hinged access plate at the bottom for entry of temporary cabling that prevents unauthorized tampering while in use.
 - ii. NEMA 4X Integrity shall be maintained while temporary cabling is connected during use
 - iii. Front and Side shall be accessible for maintenance
 - iv. Top, Side, and Bottom shall be accessible for permanent cabling
2. Powder coat
 - i. Paint after fabrication shall be Hammer tone Gray
- B. Phase, Neutral, and Ground Busbar
 1. Material: Silver-plated Copper
 2. Equipment Ground Bus: bonded to box.
 3. Isolated Ground Bus: insulated from box.
 4. Ground Bus: 50% of phase size.
 5. Neutral Bus: Neutral bus rated 100 percent of phase bus.
- C. Temporary generator and Load Bank connectors shall be Camlok style mounted on gland plate.
 1. Camlok shall be 16 Series model and color coded according to system voltage requirements.
 2. Camlok connections shall be Bus Bar Style, Cabling or Double Set Screw is not acceptable
 3. Camlok connection shall be protected against accidental contact while not in use
- D. Service Entrance Rated where indicated on drawings.
- E. Permanent Connection shall be factory installed broad range set-screw mechanical type, located behind a physical barrier
- F. Short Circuit & Withstand Rating
 1. Shall be minimum 65 KAIC unless otherwise indicated on drawings
- G. Voltage & Amperage
 1. As indicated on drawings.
- H. Factory Installed Phase Rotation Monitor Device:
 1. Phase monitoring relay to be Siemens 3U4512-1AR20 or equal and factory installed

- I. Breaker Disconnects in Permanent Line, Temporary Line, and Temporary Load Bank Positions
 - 1. Must be UL 489 Listed Breaker
 - 2. Breakers shall be removable for service and maintenance
 - 3. Interlocked permanent line breaker and temporary line breaker
- J. Additional accessories shall be included in submittal drawing as follows:
 - 1. SCADA Terminal Port
 - 2. Kirk Key Door Interlock
 - 3. Listed Monitoring Device
 - 4. Surge Protection Device
 - 5. Utility Light/Alarm

PART 3 - EXECUTION

3.1. EXAMINATION

- A. Examine elements and surfaces to receive Generator Docking Station for compliance with 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. Surface, Flush or Base Mounted: Determined by Application
 - 1. Install anchor bolts to elevations required for proper attachment to Generator Docking Station.

3.3. IDENTIFICATION

- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."
- B. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
- C. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4. FACTORY COMMISSIONING

- A. Upon completion of the installation, the docking station shall be commissioned by the Manufacturer's factory authorized technician.
- B. SCOPE OF WORK SHALL INCLUDE:

1. Review and verify the installation of all components and verify the correct electrical flow as depicted on the one-line drawings.
2. (If Applicable) The Manufacturer's authorized technician will set the long time, short time, instantaneous and ground fault protection settings on the Generator Docking Station circuit breaker(s) in accordance with the engineer's specifications or as provided as part of the coordination study.
3. Factory training for on-site personnel to educate them on how to connect the GDS to a portable generator.
4. The Manufacturer's factory authorized technician shall, upon completion of the commissioning provide a written report to the electrical contractor and electrical engineer indicating the completion of the work.
5. Any issue that is found during the start-up that is determined at that time to be a warranty issue will be covered by Manufacturer. Any issues that are specific to the scope for the electrical installing contractor are the sole responsibility of the installing contractor.
6. Upon successful completion of the commissioning, provide a complimentary 12-month warranty extension, above and beyond the 12-month manufacturer warranty.

3.5. FIELD QUALITY CONTROL

A. Third Party Tests and Inspections to include the following:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

B. Prepare test and inspection reports, including a certified report that identifies Generator Docking Station and that describes scanning results. Include notation.

END OF SECTION 262550

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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. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Communications outlets.
 - 3. Snap switches and wall-box dimmers.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. TVSS: Transient voltage surge suppressor.
- F. UTP: Unshielded twisted pair.

1.4 ACTION 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. Field quality-control test reports.
- D. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

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1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- B. Comply with NFPA 70.

1.6 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

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. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Cooper Wiring Devices, Inc.
 - b. Hubbell Premise Wiring.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).

2.3 GFCI RECEPTACLES

- A. Tamper-Resistant GFCI Convenience Receptacles, 125 V, 20 A:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

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- a. Hubbell.
- b. Pass & Seymour/Legrand (Pass & Seymour).

2.4 TOGGLE SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Manufacturers:

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

- a. Cooper Wiring Devices, Inc.
- b. Hubbell.
- c. Leviton Manufacturing Co., Inc.
- d. Pass & Seymour/Legrand (Pass & Seymour).

C. Switches, 120/277 V, 20 A:

- 1. Description: Refer to drawings for pole configuration

D. Pilot Light Switches, 20 A:

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

- a. Cooper; 2221PL for 120 V and 277 V.
- b. Hubbell; HPL1221PL for 120 V and 277 V.
- c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
- d. Pass & Seymour; PS20AC1-PLR for 120 V.

- 2. Description: Single pole, with lighted handle, illuminated when switch is "ON."

E. Key Switch

- 1. Tumbler style maximum security grade harden lock keyed per the owners requirements.
 - a. Provide a enclosed single pole or three way operator on the rear of the operator as specified o the floor plans.

2.5 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: Steel with white baked enamel, suitable for field painting.
- 3. Material for Unfinished Spaces: Galvanized steel.
- 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

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- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant , extra-duty rated, while-in-use, die-cast aluminum with lockable cover.
- C. Secure and inmate accessible locations (as defined by the architectural plans)
 - 1. Plate-Securing Screws: Torx head, 1/4x20 center rejection pin type stainless steel screws for all device plates within the project.
 - 2. Material for Finished Spaces: Heavy duty, die formed, 10 gauge, cold rolled steel finished in baked white enamel with openings to suit devices. Security wall plates shall be equal to:
 - a. Fail-Safe SSB/SPC series
 - b. Hubbell SWP series
 - c. Kenall WSP/WPP series
 - 3. Back Plate: Heavy duty, 12 gauge steel back plates with locking wings shall be set in place during construction of masonry walls, poured in place concrete and pre-cast assemblies. Steel back plates installed in masonry construction shall be solidly grouted in place.
 - 4. Provide seamless wall plate covers for all devices ganged in a common box.

2.6 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
 - 1. Wiring Devices Not Connected to UPS Power System: White, unless otherwise indicated or required by NFPA 70 or device listing.
 - 2. Wiring Devices Connected to UPS Power System: Orange.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide Inmate Accessible Location plates and tamper proof receptacles in all inmate accessible and secure areas. as defined by the architectural plans.
- B. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- C. Coordination with Other Trades:
 - 1. Take steps to ensure 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.
- D. Conductors:

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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.

E. 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.

F. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

G. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

H. 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 durable wire markers or tags inside outlet boxes.

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3.3 WARRANTY

- A. Warranty: Replace devices that fail in materials or workmanship within One year from date of Final Completion.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 - 1. Test Instruments: Use instruments that comply with UL 1436.
 - 2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.
- B. Tests for Convenience Receptacles:
 - 1. Line Voltage: Acceptable range is 105 to 132 V.
 - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
 - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 - 6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 262726

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SECTION 262813 - FUSES

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 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 3. Current-limitation curves for fuses with current-limiting characteristics.
 4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in electronic format suitable for use in coordination software and in PDF format.
 5. Coordination charts and tables and related data.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
1. Ambient temperature adjustment information.
 2. Current-limitation curves for fuses with current-limiting characteristics.
 3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse used on the Project. Submit in electronic format suitable for use in coordination software and in PDF format.
 4. Coordination charts and tables and related data.

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1.4 FIELD CONDITIONS

- A. exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Cooper Bussmann; a division of Cooper Industries.
 - 2. Edison; a brand of Cooper Bussmann; a division of Cooper Industries.
 - 3. Littelfuse, Inc.
- B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
 - 1. Type RK-1: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
 - 2. Type CC: 600-V, zero- to 30-A rating, 200 kAIC , time delay.
 - 3. Type J: 600-V, zero- to 600-A rating, 200 kAIC.
 - 4. Type L: 600-V, 601- to 6000-A rating, 200 kAIC, time delay.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

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- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:

- 1. Service Entrance: Class L, time delay.
- 2. Feeders: Class RK1, time delay.
- 3. Motor Branch Circuits: Class RK5, time delay.
- 4. Large Motor Branch (601-4000 A): Class L, time delay.
- 5. Power Electronics Circuits: Class J, high speed.
- 6. Other Branch Circuits: Class RK1, time delay.
- 7. Control Transformer Circuits: Class CC, time delay, control transformer duty.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

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SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

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 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
 - 5. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

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1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NFPA 70.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
 2. Altitude: Not exceeding 6600 feet.
- B. Interruption of Existing Electric Service: If indicated on the drawings, Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
1. Notify **Owner** no fewer than **seven** days in advance of proposed interruption of electric service.
 2. Indicate method of providing temporary electric service.
 3. Do not proceed with interruption of electric service without **Owner's** written permission.
 4. Comply with NFPA 70E.

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1.8 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

- 2.1 All panelboards, switchboards, circuit breakers, dry type transformers and disconnect switches shall be of the same manufacturer.

2.2 NONFUSIBLE & FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Eaton Electrical Sector; Eaton Corporation.
 - 2. General Electric Company.
 - 3. Siemens Industry, Inc.
 - 4. Square D.
- B. Type HD, Heavy Duty, Single Throw, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 - 4. Auxiliary Contact Kit: **One** NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
 - 5. Lugs: Mechanical type, suitable for number, size, and conductor material.
 - 6. Service-Rated Switches: When indicated on the drawings, Labeled for use as service equipment.

2.3 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Eaton Electrical Sector; Eaton Corporation.
 - 2. General Electric Company.
 - 3. Siemens Industry, Inc.
 - 4. Square D.

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- 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. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
 - 1. Instantaneous trip.
 - 2. Long- and short-time pickup levels.
 - 3. Long- and short-time time adjustments.
 - 4. Ground-fault pickup level, time delay, and I^2t response.
- F. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- G. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.
- H. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- I. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).
- J. 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. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
 - 4. Ground-Fault Protection: Comply with UL 1053; **integrally mounted, self-powered** type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
 - 5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.

2.4 MOLDED-CASE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Eaton Electrical Sector; Eaton Corporation.

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2. General Electric Company.
 3. Siemens Industry, Inc.
 4. Square D.
- B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.
- C. Features and Accessories:
1. Standard frame sizes and number of poles.
 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
 3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
 4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.

2.5 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 2. Outdoor Locations: NEMA 250, Type 4X.
 3. Kitchen and Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
 4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with 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. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Install fuses in fusible devices.
- C. Comply with NECA 1.

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3.3 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

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- B. Set field-adjustable circuit-breaker trip ranges.

END OF SECTION 262816

SECTION 262913 - ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes the following enclosed controllers rated 600 V and less:
 - 1. Full-voltage manual.
 - 2. Full-voltage magnetic.
 - 3. Combination magnetic starter/disconnect switch.
- B. Related Section:
 - 1. Division 23 Section "Variable-Frequency Motor Controllers" for general-purpose, ac, adjustable-frequency, pulse-width-modulated controllers for use on variable torque loads in ranges up to 200 hp.

1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. N.C.: Normally closed.
- E. N.O.: Normally open.
- F. OCPD: Overcurrent protective device.
- G. SCR: Silicon-controlled rectifier.

1.4 SUBMITTALS

- A. Product Data: For each type of enclosed controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.

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- B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.
 - 1. Show tabulations of the following:
 - a. Each installed unit's type and details.
 - b. Factory-installed devices.
 - c. Nameplate legends.
 - d. Short-circuit current rating of integrated unit.
 - e. Listed and labeled for integrated short-circuit current (withstand) rating of OCPDs in combination controllers by an NRTL acceptable to authorities having jurisdiction.
 - f. Features, characteristics, ratings, and factory settings of individual OCPDs in combination controllers.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Field quality-control reports.
- D. Operation and Maintenance Data: For enclosed controllers 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. Routine maintenance requirements for enclosed controllers and installed components.
 - 2. Manufacturer's written instructions for setting field-adjustable overload relays.
- E. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 113 deg F (45 deg C).
 - 2. Altitude: Not exceeding 6600 feet (2010 m).

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1.7 COORDINATION

- A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

1.8 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. Indicating Lights: Two of each type and color installed.
 - 2. Auxiliary Contacts: Furnish one spare for each size and type of magnetic controller installed.
 - 3. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

PART 2 - PRODUCTS

2.1 FULL-VOLTAGE CONTROLLERS

- A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle action; marked to show whether unit is off, on, or tripped.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Rockwell Automation, Inc.; Allen-Bradley brand.
 - d. Siemens Energy & Automation, Inc.
 - e. Square D; a brand of Schneider Electric.
 - 2. Configuration: Nonreversing.
 - 3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.
 - 4. Surface mounting.
 - 5. Red pilot light.
- C. Magnetic Controllers: Full voltage, across the line, electrically held.

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1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Rockwell Automation, Inc.; Allen-Bradley brand.
 - d. Siemens Energy & Automation, Inc.
 - e. Square D; a brand of Schneider Electric.
2. Configuration: Nonreversing.
3. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.
 - a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
4. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
5. Control Circuits: 120V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate integral devices, remotely located pilot, indicating, and control devices.
 - a. CPT Capacity: 500 VA.
6. Bimetallic Overload Relays (unless otherwise noted):
 - a. Inverse-time-current characteristic.
 - b. Class 10 tripping characteristic.
 - c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
 - d. Ambient compensated.
7. Solid-State Overload Relay (smoke control SEF and OAF fans):
 - a. Switch or dial selectable for motor running overload protection.
 - b. Sensors in each phase.
 - c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
 - d. Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
- D. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

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- b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Rockwell Automation, Inc.; Allen-Bradley brand.
 - d. Siemens Energy & Automation, Inc.
 - e. Square D; a brand of Schneider Electric.
- 2. Fusible Disconnecting Means:
 - a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate Class R fuses.
 - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
- 3. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.

2.2 ENCLOSURES

- A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.
 - 1. Dry and Clean Indoor Locations: Type 1.
 - 2. Outdoor Locations: Type 4X.

2.3 ACCESSORIES

- A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
 - 1. Pilot Lights and Selector Switches: Heavy-duty type.
 - a. Pilot Lights: LED type; Red when "ON". Green when "OFF (safe)".
 - b. Selector Switches: Rotary type "Hand-Off-Auto (HOA)."
- B. Reversible N.C./N.O. auxiliary contact(s).
- C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.
- D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

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- B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."
- B. Install fuses in each fusible-switch enclosed controller.
- C. Install fuses in control circuits if not factory installed. Comply with requirements in Division 26 Section "Fuses."
- D. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.
- E. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- F. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved nameplate.
 - 3. Label each enclosure-mounted control and pilot device.

3.4 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers and remote devices.
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic-control selection devices where applicable.
 - 1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.

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3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Inspect and test controllers, wiring, components, connections, and equipment installation.
 - 2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
 - 3. Test continuity of each circuit.
 - 4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect before starting the motor(s).
 - 5. Test each motor for proper phase rotation.
 - 6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Enclosed controllers will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

- A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

3.7 WARRANTY

- A. Warranty: Repair or replace equipment that fail in materials or workmanship within One year from date of Final Completion.

3.8 PROTECTION

- A. Replace controllers whose interiors have been exposed to water or other liquids prior to Final Acceptance.

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3.9 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

END OF SECTION 262913

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SECTION 263600 - TRANSFER SWITCHES

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 transfer switches rated 600 V and less, including the following:
 - 1. Nonautomatic transfer switches.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
- C. Qualification Data: For manufacturer.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Closeout Procedures," include the following:
 - 1. Features and operating sequences, both automatic and manual.
 - 2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.
- B. Source Limitations: Obtain automatic transfer switches through one source from a single manufacturer.

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- C. Comply with NEMA ICS 1.
 - D. Comply with NFPA 70.
- 1.5 The transfer switch to be warranted by the manufacturer for a period of five (5) years, from the date of final inspection and acceptance. The warranty shall be included in the contract document. The warranty shall include all parts, labor (including travel), expenses and equipment necessary to perform replacement and/or repairs.”

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers approved that may be incorporated into the Work.
 - a. [ASCO](#)
 - b. [Kohler Power Systems.](#)
 - c. [Onan/Cummins Power Generation.](#)
 - d. [Russelectric, Inc.](#)
 - e. [Eaton Electrical Sector; Eaton Corporation.](#)
 - f. [GE Zenith Controls](#)

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

- A. Refer to the drawings for the specific requirements of each transfer switch and apply the requirements indicated herein as required. Unless specified otherwise all transfer switches shall be 3 poles,
- B. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.
- C. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008. Where the fault current rating indicated on the drawings is not available in the size indicated, provide the lowest sized equipment that will meet the rating indicated.
 - 1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
- D. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- E. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

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- F. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.
- G. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
 - 1. Switch Action: Double throw; mechanically held in both directions.
 - 2. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.
- H. Neutral Terminal: Solid and fully rated, unless otherwise indicated.
- I. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Division 26 Section "Identification for Electrical Systems."
 - 1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
 - 2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
 - 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
- J. Enclosures:
 - 1. General-purpose, indoors NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.
 - 2. Outdoor: NEMA 4X

2.3 NONAUTOMATIC TRANSFER SWITCHES

- A. Non Automatic Transfer switches shall only be provided where specifically indicated on the drawings.
- B. Operation: Electrically actuated by push buttons designated "Normal Source" and "Alternate Source." In addition, removable manual handle provides quick-make, quick-break manual-switching action. Switch shall be capable of electrically or manually transferring load in either direction with either or both sources energized. Control circuit disconnects from electrical operator during manual operation.
- C. Double-Throw Switching Arrangement: Incapable of pauses or intermediate position stops during switching sequence.
- D. Nonautomatic Transfer-Switch Accessories:
 - 1. Pilot Lights: Indicate source to which load is connected.
 - 2. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and alternate-source sensing circuits.
 - a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."

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- b. Emergency Power Supervision: Red light with nameplate engraved "Alternate Source Available."
- 3. Unassigned Auxiliary Contacts: One set of normally closed contacts for each switch position, rated 10 A at 240-V ac.
- E. External connections: Lugs sized to accept up to three 600KCM cables per phase. Solid neutral connection shall be to same size as the phase connections. Ground connect as required by NEMA and NEC.

2.4 SERVICE ENTRANCE RATED TRANSFER SWITCHES

- A. Where indicated on the drawing, provide equipment that is UL listed and tested for use as service entrance equipment. Provide an integral breaker in the equipment to disconnect the normal power source.
- B. Arc Energy Reduction. Where the highest continuous current trip setting of a circuit breaker is rated or can be adjusted to is 1200 A or higher.
 - 1. Provide one of the following methods to reduce clearing time
 - a. Zone-selective interlocking
 - b. Differential relaying
 - c. Energy-reducing maintenance switching with local status indicator
 - d. Energy-reducing active arc flash mitigation system
 - 2. Indicate the method of compliance in the submittals
 - 3. Provide documentation how the breaker is authorized to be installed, operated, and/or inspected
 - 4. Contractor shall adhere to the documentation and post the information at the location of the circuit breaker(s).

2.5 SOURCE QUALITY CONTROL

- A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Identify components according to Division 26 Section "Identification for Electrical Systems."
- B. Set field-adjustable intervals and delays and relays.

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3.2 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 - 1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
 - a. Check for electrical continuity of circuits and for short circuits.
 - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
 - c. Verify that manual transfer warnings are properly placed.
 - d. Perform manual transfer operation.
 - 4. MTS Testing: Demonstrate interlocking sequence and operational function for each switch.
 - a. The owner will provide a portable generator for testing. Notify the owner at least ten business day prior to the scheduled test. The contractor shall pay for the fuel for testing.
 - b. Connect the portable generator to the MTS, turn off the all the breakers in the panel connected to the MTS, energized the emergency source and transfer the load to the portable generator sequentially by closing the breakers in the panel connected to the MTS and monitoring connected load on the panelboard meter. If the entire load of the panel cannot be supported by the portable generator, demonstrate that all the loads are capable of being supplied by the generator by manually operating the breakers in the panel and monitoring the meter for the panel.
 - c. Should any portion of the system fail testing, the contractor shall bear the cost of correcting the failure and renting a generator for retesting.

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3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Division 01 Section "Closeout Procedures."

3.5 WARRANTY

- A. Warranty Period: Provide a warranty to repair or replace for One year from date of Final Acceptance.

END OF SECTION 263600

SECTION 26431 –SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. Section includes field-mounted SPD for low-voltage (120 to 600 V) power distribution and control equipment.
- B. Related Sections:
 - 1. Division 26 Section "Panelboards" for factory-installed SPD.
 - 2. Division 26 Section "Wiring Devices" for devices with integral SPD.

1.3 DEFINITIONS

- A. ATS: Acceptance Testing Specifications.
- B. SVR: Suppressed voltage rating.
- C. SPD: Surge Protection Device, both singular and plural; also, transient voltage surge suppression. Where TVSS is used in the Contract Documents, it shall be construed to mean SPD Surge Protective Device(s).

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating weights, electrical characteristics, furnished specialties, and accessories.
- B. Product Certificates: For SPD devices, from manufacturer.
- C. Field quality-control reports.
- D. Operation and Maintenance Data: For SPD devices to include in emergency, operation, and maintenance manuals.
- E. Warranties: Sample of special warranties.

1.5 PROJECT CONDITIONS

- A. Service Conditions: Rate SPD devices for continuous operation under the following conditions unless otherwise indicated:
 - 1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
 - 2. Operating Temperature: 30 to 120 deg F (0 to 50 deg C).
 - 3. Humidity: 0 to 85 percent, noncondensing.
 - 4. Altitude: Less than 20,000 feet (6090 m) above sea level.

1.6 COORDINATION

- A. Coordinate location of field-mounted SPD devices to allow adequate clearances for maintenance.
- B. Coordinate SPD devices with Division 26 Section "Electrical Power Monitoring and Control."

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within specified warranty period of five years from date of **Final Acceptance**

PART 2 - PRODUCTS

2.1 SERVICE ENTRANCE SUPPRESSORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Advanced Protection Technologies Inc. (APT).
 - 2. Current Technology Inc.; Danaher Power Solutions.
 - 3. Danaher Power Solutions; United Power Products.
 - 4. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 5. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 6. Liebert Corporation; a division of Emerson Network Power.
 - 7. Northern Technologies, Inc.; a division of Emerson Network Power.
 - 8. Siemens Energy & Automation, Inc.
 - 9. Square D; a brand of Schneider Electric.
 - 10. Surge Suppression Incorporated.
- B. Surge Protection Devices:
 - 1. Comply with UL 1449 latest edition.
 - 2. IEEE C62.41 Category C device.
 - 3. Fabrication using bolted compression lugs for internal wiring.

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4. Integral disconnect switch.
 5. Redundant suppression circuits.
 6. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
 7. LED indicator lights for power and protection status.
 8. Audible alarm, with silencing switch, to indicate when protection has failed.
 9. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
 10. Transient-event counter set to totalize transient surges.
- C. Peak Single-Impulse Surge Current Rating: 240 kA per mode/480 kA per phase.
- D. Minimum single impulse current ratings, using 8-by-20-mic.sec waveform described in IEEE C62.41.2.
1. Line to Neutral: 70,000 A.
 2. Line to Ground: 70,000 A.
 3. Neutral to Ground: 50,000 A.
- E. Protection modes and UL 1449 SVR for grounded wye circuits with 480Y/277 V, 3-phase, 4-wire circuits shall be as follows:
1. Line to Neutral: 800 V for 480Y/277 V.
 2. Line to Ground: 800 V for 480Y/277 V.
 3. Neutral to Ground: 800 V for 480Y/277 V.
- F. The SPD equipment shall have the following noise filtering levels
- | Frequency | 100 kHz | 1 MHz | 10 MHz | 100MHz |
|-----------------------|---------|-------|--------|--------|
| Noise Filtering Level | 34 dB | 51dB | 54 dB | 48 dB |
- G. SPD units shall be mounted integral with the main distribution switchboard MDS and emergency distribution switchboard EDS, and listed for use with the equipment provided.

2.2 PANELBOARD SUPPRESSORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Advanced Protection Technologies Inc. (APT).
 2. Current Technology Inc.; Danaher Power Solutions.
 3. Danaher Power Solutions; United Power Products.
 4. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 5. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 6. Liebert Corporation; a division of Emerson Network Power.
 7. Northern Technologies, Inc.; a division of Emerson Network Power.
 8. Siemens Energy & Automation, Inc.

9. Square D; a brand of Schneider Electric.
10. Surge Suppression Incorporated.

B. Surge Protection Devices:

1. Comply with UL 1449 second edition.
2. IEEE C.62.41 Category B device.
3. Short-circuit current rating complying with UL 1449, and matching or exceeding the panelboard short-circuit rating and redundant suppression circuits; with individually fused metal-oxide varistors.
4. Fabrication using bolted compression lugs for internal wiring.
5. Integral disconnect switch.
6. Redundant suppression circuits.
7. Redundant replaceable modules.
8. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
9. LED indicator lights for power and protection status.
10. Audible alarm, with silencing switch, to indicate when protection has failed.
11. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
12. Transient-event counter set to totalize transient surges.

C. Peak Single-Impulse Surge Current Rating: 80 kA per mode/160 kA per phase.

D. Minimum single impulse current ratings, using 8-by-20-mic.sec waveform described in IEEE C62.41.2:

1. Line to Neutral: 70,000 A.
2. Line to Ground: 70,000 A.
3. Neutral to Ground: 50,000 A.

E. Protection modes and UL 1449 SVR for grounded wye circuits with 208Y/120 V, 3-phase, 4-wire circuits shall be as follows:

1. Line to Neutral: 800 V for 480Y/277 V or 400 V for 208Y/120 V.
2. Line to Ground: 800 V for 480Y/277 V or 400 V for 208Y/120 V.
3. Neutral to Ground: 800 V for 480Y/277 V or 400 V for 208Y/120 V.

F. SPD unit shall be mounted integral with the panelboard served, and listed for use with the equipment provided or enclosure shall be NEMA 250, with type matching the enclosure of panel or device being protected. The enclosure shall be suitable for the location in which it is installed, indoors or outdoors. Install the SPD unit as close as possible to the equipment served. Provide a 3-pole circuit breaker or fuse in the equipment to serve as a SPD disconnect means.

2.3 ENCLOSURES

A. Indoor Enclosures: NEMA 250 Type 1.

- B. Outdoor Enclosures: NEMA 250 Type 3R.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install SPD devices at service entrance on load side, with ground lead bonded to service entrance ground.
- B. Install SPD devices for panelboards and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
 - 1. Provide multi pole, 60-A circuit breaker as a dedicated disconnecting means for SPD unless otherwise indicated.

3.2 FIELD QUALITY CONTROL

- A. 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.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.
 - 2. After installing SPD devices but before electrical circuitry has been energized, test for compliance with requirements.
 - 3. Complete startup checks according to manufacturer's written instructions.
- C. SPD device will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.3 STARTUP SERVICE

- A. Do not energize or connect service entrance equipment or panelboards to their sources until SPD devices are installed and connected.
- B. Do not perform insulation resistance tests of the distribution wiring equipment with the SPD installed. Disconnect before conducting insulation resistance tests and reconnect immediately after the testing is complete.

3.4 WARRANTY

- A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace equipment that fail in materials or workmanship within One year from date of Final Completion.

3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to maintain SPD devices.

END OF SECTION 264313

SECTION 265119 - LED INTERIOR LIGHTING

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 solid-state luminaires that use LED technology.
 - 2. Exit Signs
 - 3. Lighting fixture supports.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.
 - 3. Include physical description and dimensions of luminaires.
 - 4. Include emergency lighting units, including batteries and chargers.
 - 5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
 - 6. Photometric data and adjustment factors based on laboratory tests.

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7. Confirmation of compliance with Design Lighting Consortium (DLC) or ENERGY STAR product requirements.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Product Schedule: For luminaires. Use same designations indicated on Drawings.

- D. For each fixture provide a color palette of the manufacturer's full color offering. Indicate which colors are standard (no additional cost) and which are custom (additional cost). Architect shall pick the color of all fixtures at the time of the submittal.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Provide luminaires from a single manufacturer for each luminaire type.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.8 FIELD CONDITIONS

- A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.

1.9 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within Five years from date the Owner receives the Certificate of Occupancy or 7 years from the manufacturer's shipping date.

1. Failures include, but are not limited to, the following:
 - a. Structural failures, including luminaire support components.
 - b. Faulty operation of luminaires and accessories.

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- c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

1.10 EXTRA MATERIALS

- A. Provide extra materials described below that match products installed including installation and wiring. Uninstalled devices shall be packaged with protective covering for storage, identified with labels describing contents and turned over to the owner at the completion of the project.
 - 1. Drivers: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Globes and Guards: 1 for every 20 of each type and rating installed. Furnish at least one of each type.
 - 3. Exit signs: Provide 10% of total count but not less than 10 additional exit signs (single face or double face, as needed)
 - 4. Including 100' of conduit, boxes, wire, associated accessories and installation for each unit listed above. Units shall be installed as directed by the Architect, Owner, or Authority Having Jurisdiction (AHJ).

1.11 SUBSTITUTIONS

- A. In Lighting Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:
 - 1. Basis of Design Product: The design of each luminaire and its support is based on the first product named. Subject to compliance with requirements, provide either the named product or a comparable product by another manufacturer.
 - 2. The lighting fixture layout indicated in the Contract Documents is based upon photometric data, quality, construction and appearance of fixtures listed in the lighting fixture schedule. Substitutions of listed fixtures are allowed provided the following is provided:
 - 2. Substitution package shall be submitted to Architect no later than fifteen (15) days prior to bid for review and approval.
 - 3. Provide all data for the substitution package in a table similar in format to the lighting fixture schedule on the drawings.
 - 4. Provide cut sheets of substitute fixtures with the various features highlighted.
 - 5. Architect has final functional and aesthetic approval on all substituted fixtures.
 - 6. Pre-bid approved will still be subject to the usual post bid submittal process and review.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. All interior LED lighting fixtures shall be compliant with current product requirements of Design Lighting Consortium (DLC) or ENERGY STAR program.

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- C. Recessed Fixtures: Comply with NEMA LE 4.
- D. Lamps dimmable from 100 percent of maximum light output down to percentage listed in lighting schedule as BOD.
- E. Internal driver:
 - 1. Minimum efficiency: 85% at full load.
 - 2. Minimum Operating Ambient Temperature: -20° C. (-4° F.).
 - 3. Integral short circuit, open circuit, and overload protection.
 - 4. Power Factor: ≥ 0.95 .
 - 5. Total Harmonic Distortion: $\leq 20\%$.
 - 6. Comply with FCC 47 CFR Part 15.
- F. LED Modules:
 - 1. Comply with IES LM-79 and LM-80 requirements.
 - 2. Minimum CRI 80 and color temperature 4000° K unless otherwise specified in LIGHTING FIXTURE SCHEDULE.
 - 3. Minimum Rated Life: 50,000 hours per IES L70.
 - 4. Light output: delivered lumens as indicated in the LIGHTING FIXTURE SCHEDULE.
- G. Nominal Operating Voltage: Provide Universal voltage (120V-277V) driver where possible. Otherwise provide per the drawings.
- H. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- I. Housings:
 - 1. Extruded-aluminum or steel housing and heat sink.
 - 2. Powder-coat painted finish.

2.2 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
 - 1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
 - 2. Battery Powered Exit Signs: Integral automatic charger in a self-contained power pack.
 - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
 - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

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- f. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.

2.3 MATERIALS

A. Metal Parts:

- 1. Free of burrs and sharp corners and edges.
- 2. Sheet metal components shall be steel unless otherwise indicated.
- 3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit maintenance access without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during maintenance and when secured in operating position.

C. Diffusers:

- 1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- 2. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

D. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

- 1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage, and coating.
 - c. CCT and CRI for all luminaires.

2.4 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.5 LUMINAIRE FIXTURE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.

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- D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

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 luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and maintenance.
 - 3. Provide support for luminaire without causing deflection of ceiling or wall.
 - 4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.
- D. Flush-Mounted Luminaire Support:
 - 1. Secured to outlet box.
 - 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
 - 3. Trim ring flush with finished surface.
- E. Wall-Mounted Luminaire Support:
 - 1. Attached to structural members in walls
 - 2. Do not attach luminaires directly to gypsum board.

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F. Ceiling-Mounted Luminaire Support:

1. Ceiling mount with two 5/32-inch diameter aircraft cable supports attached to structure. Do not attached to ceiling with no additional support.

G. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

H. Ceiling-Grid-Mounted Luminaires:

1. Secure luminaire to the luminaire opening using approved fasteners in a minimum of two locations, spaced near diagonal corners of luminaire.
2. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.

- I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. Perform the following tests and inspections:
 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- C. Luminaire will be considered defective if it does not pass operation tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 265119

SECTION 270500 - COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Communications equipment coordination and installation.
 - 2. Sleeves for pathways and cables.
 - 3. Sleeve seals.
 - 4. Grout.
 - 5. Common communications installation requirements.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For sleeve seals.

1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of communications equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting pathways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

- C. Coordinate location of access panels and doors for communications items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

1.6 QUALITY ASSURANCE

- A. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment".

PART 2 - PRODUCTS

2.1 SLEEVES FOR PATHWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of pathway or cable.
3. Pressure Plates: Carbon steel with corrosion and rust-resistant coating . Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.4 SECURITY FASTENERS:

- A. Description: Accessories, anchorage inserts, and security fasteners providing a complete tamperproof installation.
- B. Exposed Security Fasteners:
 1. Fastener: Provide **torx-head** (star with center reject pin) security fasteners for anchoring work in exposed security areas.
 2. Finish: Finish shall match that specified of the item anchored.
 3. Tools: Provide tools for fastening devices.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR COMMUNICATIONS INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both communications equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Communications penetrations occur when pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pathway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pathway and cable penetrations. Install sleeves and seal pathway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between pathway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.

- B. Use type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for communications installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.5 SECURITY FASTENERS

- A. All fasteners exposed in security areas shall be security fasteners. Where standard fasteners on manufactured devices and equipment are accessible, they shall be replaced with security fasteners.

END OF SECTION 270500

SECTION 270526 - GROUNDING AND BONDING FOR COMMUNICATIONS 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.
- B. See Division 26 specification section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Grounding conductors.
 - 2. Grounding connectors.
 - 3. Grounding bus bars.
 - 4. Grounding rods.
 - 5. Grounding labeling.

1.3 DEFINITIONS

- A. BCT: Bonding conductor for telecommunications.
- B. EMT: Electrical metallic tubing.
- C. TGB: Telecommunications grounding bus bar.
- D. TMGB: Telecommunications main grounding bus bar.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For communications equipment room signal reference grid. Include plans, elevations, sections, details, and attachments to other work.

1.5 INFORMATIONAL SUBMITTALS

- A. As-Built Data: Plans showing as-built locations of grounding and bonding infrastructure, including the following:

1. Ground rods.
 2. Ground and roof rings.
 3. BCT, TMGB, TGBs, and routing of their bonding conductors.
- B. Qualification Data: For Installer, installation supervisor, and field inspector.
- C. Qualification Data: For testing agency and testing agencies field supervisor.
- D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
1. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - a. Result of the ground-resistance test, measured at the point of BCT connection.
 - b. Result of the bonding-resistance test at each TGB and its nearest grounding electrode

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
1. Installation Supervision: Installation shall be under the direct supervision of ITS Technician, who shall be present at all times when Work of this Section is performed at Project site.
 2. Field Inspector: Currently registered by B I C S I as a registered communications distribution designer to perform the on-site inspection.

PART 2 - PRODUCTS

2.1 SYSTEM COMPONENTS

- A. Comply with J-STD-607-B.

2.2 CONDUCTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Harger Lightning and Grounding.
 - 2. Panduit Corp.
 - 3. Tyco Electronics Corp.
 - 4. Approved Equal
- B. Comply with UL 486A-486B.
- C. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.
 - 1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
 - 2. Cable Tray Equipment Grounding Wire: No. 6 AWG.
- D. Cable Tray Grounding Jumper:
 - 1. Not smaller than No. 6 AWG 26 kmils (13.3 sq. mm) and not longer than 12 inches (300 mm). If jumper is a wire, it shall have a crimped grounding lug with two holes and long barrel for two crimps. If jumper is a flexible braid, it shall have a one-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.
 - 2. Not smaller than No. 10 AWG 26 kmils (13.3 sq. mm) and not longer than 12 inches (300 mm). If jumper is a wire, it shall have a crimped grounding lug with one hole and standard barrel for one crimp. If jumper is a flexible braid, it shall have a one- or two-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.
- E. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kmils (14.2 sq. mm), 14 strands of No. 17 AWG conductor, and 1/4 inch (6.3 mm) in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

2.3 CONNECTORS

- A. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.

- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Burndy; Part of Hubbell Electrical Systems.
 - 2. Chatsworth Products, Inc.
 - 3. Harger Lightning and Grounding.
 - 4. Panduit Corp.
 - 5. Tyco Electronics Corp.
 - 6. Approved Equal
- C. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.
 - 1. Electroplated tinned copper, C and H shaped.
- D. Signal Reference Grid Connectors: Combination of compression wire connectors, access floor grounding clamps, bronze U-bolt grounding clamps, and copper split-bolt connectors, designed for the purpose.
- E. Bus bar Connectors: Cast silicon bronze, solderless exothermic -type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch (15.8- or 25.4-mm) centers for a two-bolt connection to the bus bar.
- F. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.4 GROUNDING BUSBARS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Chatsworth Products, Inc.
 - 2. Harger Lightning and Grounding.
 - 3. Panduit Corp.
 - 4. Approved Equal
- B. TMGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, 1/4 by 4 inches by 24 inches (6.3 by 100 mm by 600 mm in cross section, length as indicated on Drawings. The bus bar shall be NRTL listed for use as TMGB and shall comply with J-STD-607-B.
 - 1. Pre-drilling shall be with holes for use with lugs specified in this Section.
 - 2. Mounting Hardware: Stand-off brackets that provide a 4-inch ((100-mm clearance to access the rear of the bus bar. Brackets and bolts shall be stainless steel.
 - 3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.

- C. TGB: Predrilled rectangular bars of hard-drawn solid copper, 1/4 by 2 inches (6.3 by 50 mm) in cross section, length as indicated on Drawings. The bus bar shall be for wall mounting, shall be NRTL listed as complying with UL 467, and shall comply with J-STD-607-B.
 - 1. Predrilling shall be with holes for use with lugs specified in this Section.
 - 2. Mounting Hardware: Stand-off brackets that provide at least a 2-inch ((50-mm) clearance to access the rear of the bus bar. Brackets and bolts shall be stainless steel.)
 - 3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
- D. Rack and Cabinet Grounding Bus bars: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with J-STD-607-B. Predrilling shall be with holes for use with lugs specified in this Section.
 - 1. Cabinet-Mounted Bus bar: Terminal block, with stainless-steel or copper-plated hardware for attachment to the cabinet.
 - 2. Rack-Mounted Horizontal Bus bar: Designed for mounting in 19- or 23-inch (483- or 584-mm) equipment racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack.
 - 3. Rack-Mounted Vertical Bus bar: 72 or 36 inches ((1827 or 914 mm) long, with) stainless-steel or copper-plated hardware for attachment to the rack.

2.5 GROUND RODS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Harger Lightning and Grounding.
 - 2. Tyco Electronics Corp.
 - 3. Approved Equal
- B. Ground Rods: Copper-clad steel, sectional type; 3/4 inch by 10 feet (19 mm by 3 m).

2.6 LABELING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Brother International Corporation.
 - 2. HellermannTyton.
 - 3. Panduit Corp.
 - 4. Approved Equal

- B. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.
- B. Inspect the test results of the ac grounding system measured at the point of BCT connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of the BCT only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.
- B. Comply with NECA 1.
- C. Comply with J-STD-607-B.

3.3 APPLICATION

- A. Conductors: Install solid conductor for No. 8 AWG and smaller and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
 - 1. The bonding conductors between the TGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
 - 2. The bonding conductors between the TMGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.

- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 4/0 AWG minimum.
- C. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.
- D. Conductor Support:
 - 1. Secure grounding and bonding conductors at intervals of not less than 36 inches (900 mm).
- E. Grounding and Bonding Conductors:
 - 1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
 - 2. Install without splices.
 - 3. Support at not more than 36-inch (900-mm) intervals.
 - 4. Install grounding and bonding conductors in 3/4-inch (21-mm) PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.
 - a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing that complies with requirements in Section 270528 "Pathways for Communications Systems," and bond both ends of the conduit to a TGB.

3.4 GROUNDING ELECTRODE SYSTEM

- A. The BCT between the TMGB and the ac service equipment ground shall not be smaller than No. 4/0 AWG.

3.5 GROUNDING BUSBARS

- A. Indicate locations of grounding bus bars on Drawings. Install bus bars horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 12 inches (300 mm) above finished floor unless otherwise indicated.
- B. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

3.6 CONNECTIONS

- A. Bond metallic equipment in a telecommunications equipment room to the grounding bus bar in that room, using equipment grounding conductors not smaller than No. 6 AWG.
- B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.
- C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:
 - 1. Use crimping tool and the die specific to the connector.
 - 2. Pre-twist the conductor.
 - 3. Apply an antioxidant compound to all bolted and compression connections.
- D. Primary Protector: Bond to the TMGB with insulated bonding conductor.
- E. Interconnections: Interconnect all TGBs with the TMGB with the telecommunications backbone conductor. If more than one TMGB is installed, interconnect TMGBs using the grounding equalizer conductor. The telecommunications backbone conductor and grounding equalizer conductor size shall not be less than 2 kmils/linear foot (1 sq. mm/linear meter) of conductor length, up to a maximum size of No. 4/0 AWG 168 kmils (85 sq. mm) unless otherwise indicated.
- F. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install vertically mounted rack grounding busbar unless the enclosure and rack are manufactured with the busbar. Bond the equipment grounding busbar to the TGB No. 2 AWG bonding conductors.
- G. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each TGB and TMGB to the vertical steel of the building frame.
- H. Electrical Power Panel boards: Where an electrical panel board for telecommunications equipment is located in the same room or space, bond each TGB to the ground bar of the panel board.
- I. Shielded Cable: Bond the shield of shielded cable to the TGB in communications rooms and spaces. Comply with TIA/EIA-568-C.1 and TIA/EIA-568-C.2 when grounding screened, balanced, twisted-pair cables.
- J. Rack- and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.
- K. Access Floors: Bond all metal parts of access floors to the TGB.

- L. Equipment Room Signal Reference Grid: Provide a low-impedance path between telecommunications cabinets, equipment racks, and the reference grid, using No. 6 AWG bonding conductors.
 - 1. Install the conductors in grid pattern on 4-foot (1200-mm) centers, allowing bonding of one pedestal from each access floor tile.
 - 2. Bond the TGB of the equipment room to the reference grid at two or more locations.
 - 3. Bond all conduits and piping entering the equipment room to the TGB at the perimeter of the room.
- M. Towers and Antennas:
 - 1. Ground Ring: Buried at least 30 inches (760 mm) below grade and at least 24 inches (610 mm) from the base of the tower or mounting.
 - 2. Bond each tower base and metallic frame of a dish to the ground ring, buried at least 18 inches (460 mm) below grade.
 - 3. Bond the ground ring and antenna grounds to the equipment room TMGB or TGB, buried at least 30 inches (760 mm) below grade.
 - 4. Bond metallic fences within 6 feet (1.8 m) of towers and antennas to the ground ring, buried at least 18 inches (460 mm) below grade.
 - 5. Special Requirements for Roof-Mounted Towers:
 - a. Roof Ring: Meet requirements for the ground ring except the conductors shall comply with requirements in Section 264113 "Lightning Protection for Structures."
 - b. Bond tower base footings steel, the TGB in the equipment room, and antenna support guys to the roof ring.
 - c. Connect roof ring to the perimeter conductors of the lightning protection system.
 - 6. Waveguides and Coaxial Cable:
 - a. Bond cable shields at the point of entry into the building to the TGB and to the cable entrance plate, using No. 2 AWG bonding conductors.
 - b. Bond coaxial cable surge arrester to the ground or roof ring using bonding conductor size recommended by surge-arrester manufacturer.

3.7 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.
- B. Comply with IEEE C2 grounding requirements.
- C. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) extends above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall.

Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, non-shrink grout.

- D. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, bonding conductor. Train conductor's level or plumb around corners and fasten to manhole walls. Connect grounding conductors to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

3.8 IDENTIFICATION

- A. Labels shall be preprinted or computer-printed type.
1. Label TMGB(s) with "fs-TMGB," where "fs" is the telecommunications space identifier for the space containing the TMGB.
 2. Label TGB(s) with "fs-TGB," where "fs" is the telecommunications space identifier for the space containing the TGB.
 3. Label the BCT and each telecommunications backbone conductor at its attachment point: "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 2. Test the bonding connections of the system using an ac earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing a TMGB and a TGB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.
 - a. Measure the resistance between the bus bar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms.
 3. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.

- a. With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the TMGB and in each TGB . Maximum acceptable ac current level is 1 A.
- D. Excessive Ground Resistance: If resistance to ground at the BCT exceeds 5 ohms, notify Architect promptly and include recommendations to reduce ground resistance.
- E. Grounding system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION 270526

SECTION 270527 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Metal conduits and fittings.
 - 2. J-Hooks
 - 3. Optical-fiber-cable pathways and fittings.
 - 4. Surface pathways.
 - 5. Boxes, enclosures, and cabinets.

- B. Related Requirements:

- 1. Division 26 Section "Raceways and Boxes for Electrical Systems" for conduits, wireways, surface raceways, boxes, enclosures, cabinets, hand holes, and faceplate adapters serving electrical systems.

1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

- A. Product Data: For surface pathways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.
- C. Samples: For wire ways, nonmetallic wire ways, and surface pathways and for each color and texture specified, 12 inches (300 mm) long.

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- D. Quality Assurance: All field design submittals for Div. 27 specifications shall be done by an RCDD or under the guidance of an RCDD.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
1. Structural members in paths of pathway groups with common supports.
 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following provide products by one of the following:
1. AFC Cable Systems, Inc.
 2. Allied Tube & Conduit.
 3. Alpha Wire Company.
 4. Anamet Electrical, Inc.
 5. Electri-Flex Company.
 6. O-Z/Gedney.
 7. Picoma Industries.
 8. Republic Conduit.
 9. Robroy Industries.
 10. Southwire Company.
 11. Thomas & Betts Corporation.
 12. Western Tube and Conduit Corporation.
 13. Wheatland Tube Company.
 14. Approved Equal
- B. General Requirements for Metal Conduits and Fittings:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Comply with TIA-569-B.

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- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. ARC: Comply with ANSI C80.5 and UL 6A.
- E. IMC: Comply with ANSI C80.6 and UL 1242.
- F. PVC-Coated Steel Conduit: PVC-coated IMC
 - 1. Comply with NEMA RN 1.
 - 2. Coating Thickness: 0.040 inch (1 mm), minimum.
- G. EMT: Comply with ANSI C80.3 and UL 797.
- H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
 - 2. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: compression.
 - 3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.
 - 4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
- I. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.6 SURFACE PATHWAYS

- A. General Requirements for Surface Pathways:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Comply with TIA-569-C.
- B. Surface Metal Pathways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
 - a. Mono-Systems, Inc.
 - b. Niedax-Kleinhuis USA, Inc.

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- c. Panduit Corp.
 - d. Wiremold / Legrand.
 - e. Approved Equal
- C. Surface Nonmetallic Pathways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL-94 V-0 requirements for self-extinguishing characteristics.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Lamson & Sessions; Carlon Electrical Products.
 - b. Mono-Systems, Inc.
 - c. Panduit Corp.
 - d. Quazite:Hubbell Power Systems, Inc.
 - e. Wiremold / Legrand.
 - f. Approved Equal

2.7 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1. Adalet.
 - 2. Cooper Technologies Company; Cooper Crouse-Hinds.
 - 3. EGS/Appleton Electric.
 - 4. Erickson Electrical Equipment Company.
 - 5. Hoffman.
 - 6. Lamson & Sessions; Carlon Electrical Products.
 - 7. Milbank Manufacturing Co.
 - 8. Molex; Woodhead Brand.
 - 9. Mono-Systems, Inc.
 - 10. O-Z/Gedney.
 - 11. Quazite:Hubbell Power Systems, Inc.
 - 12. RACO; Hubbell.
 - 13. Robroy Industries.
 - 14. Spring City Electrical Manufacturing Company.
 - 15. Stahlin Non-Metallic Enclosures.
 - 16. Thomas & Betts Corporation.
 - 17. Wiremold / Legrand.
- B. Approved Equal - General Requirements for Boxes, Enclosures, and Cabinets:
- 1. Comply with TIA-569-C.

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2. Boxes, enclosures and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet-Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy Type FD, with gasketed cover.
- E. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- F. Metal Floor Boxes:
 1. Material: Cast metal or sheet metal.
 2. Type: Fully adjustable
 3. Shape: Rectangular.
 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum galvanized, or cast iron with gasketed cover.
- I. Device Box Dimensions: 4 inches by 2-1/8 inches by 2-1/8 inches deep (100 mm by 60 mm by 60 mm deep)
- J. Gangable boxes are allowed
- K. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- L. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 4 with continuous- hinge cover with flush latch unless otherwise indicated.
 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 2. Nonmetallic Enclosures:
 - a. Material: Fiberglass .
 - b. Finished inside with radio-frequency-resistant paint.
 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- M. Cabinets:

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1. NEMA 250, Type 3R 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 panel boards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.10 FIRESTOP FLOOR AND WALL PENETRATIONS

- A. See specifications in Division 26.

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

- A. Outdoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC
2. Concealed Conduit, Aboveground: IMC.
3. Underground Conduit: RNC, Type EPC-40-PVC concrete encased .
4. Boxes and Enclosures, Aboveground: NEMA 250, Type 4.

- B. Indoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT
2. Exposed, Not Subject to Severe Physical Damage: EMT
3. Exposed and Subject to Severe Physical Damage: GRC
 - 1 Pathway locations include the following:
 - a All spaces within the secure perimeter
 - b Mechanical rooms.
4. Concealed in Interior Walls and Partitions: EMT
5. Concealed in Accessible Ceilings: J-hooks
6. Damp or Wet Locations: GRC
7. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: EMT
8. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: EMT
9. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: EMT
10. Boxes and Enclosures: NEMA 250 Type 1, except use NEMA 250 Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations. Minimum Pathway Size: 1-inch (21-mm) trade size. Minimum size for optical-fiber cables is 2 inch (27 mm).

- C. Pathway Fittings: Compatible with pathways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.

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2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
- D. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- E. Install surface pathways only where indicated on Drawings.
- F. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C)

3.2 INSTALLATION

- A. Comply with NECA 1, NECA 101, and TIA-569-C for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum pathways. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.
- B. Keep pathways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
- C. Complete pathway installation before starting conductor installation.
- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches (300 mm) of changes in direction. Utilize long radius ells for all optical-fiber cables.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- I. Pathways Embedded in Slabs:
1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot (3-m) intervals.
 2. Arrange pathways to cross building expansion joints at right angles with expansion fittings.
 3. Arrange pathways to keep a minimum of 2 inches (50 mm) of concrete cover in all directions.

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4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
 5. Change from EMT to GRC or before rising above floor.
- J. Stub-ups to Above Recessed Ceilings:
1. Use EMT, IMC, or RMC for pathways.
 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.
- L. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.
- M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.
- N. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- O. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- P. Cut conduit perpendicular to the length. For conduits of 2-inch (53-mm) trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
- Q. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground pathways designated as spare above grade alongside pathways in use.
- R. Surface Pathways:
1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.
 2. Install surface pathway with a minimum 2-inch (50-mm) radius control at bend points.
 3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- S. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:
1. 3/4-Inch (21-mm) Trade Size and Smaller: Install pathways in maximum lengths of 50 feet (15 m).

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2. 1-Inch (27-mm) Trade Size and Larger: Install pathways in maximum lengths of 75 feet (23 m).
 3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- T. Install pathway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway sealing fittings according to NFPA 70.
- U. Install devices to seal pathway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where an underground service pathway enters a building or structure.
 3. Where otherwise required by NFPA 70.
- V. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.
- W. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).
 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
 - d. Attics: 135 deg F (75 deg C) temperature change.
 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115

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- mm per meter of length of straight run per deg C) of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- X. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- Y. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- AA. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- BB. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- CC. Set metal floor boxes level and flush with finished floor surface.
- DD. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
- 3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS
- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."
- 3.6 FIRESTOPPING
- A. Install fire stopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Fire stopping."
- 3.7 PROTECTION
- A. Protect coatings, finishes, and cabinets from damage or deterioration.
1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

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2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 270527

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SECTION 276410 - RADIO FREQUENCY (RF) BDA-BASED SIGNAL BOOSTER SYSTEMS
(IN-BUILDING RADIO SYSTEM COVERAGE)

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. The contractor will design a fully functional signal booster system and furnish, install and provide a one-year warranty from Final Acceptance for the cabling, conduit and pathways for a designed signal booster system.

1.1 SUBMITTALS

- B. Product Data: For each type of product indicated.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Functional Block Diagram: Show single-line interconnections between components for the distribution system. Show cable types and sizes.
 - 2. Wiring Diagrams: For power, signal, and control wiring and transmission cable, include cross connects, taps, and other connections cords.
- D. Design Calculations: Calculate signal attenuation budget and show calculated line and equipment losses for the system based on the functional block diagram, to show that proposed system layout can be expected to perform up to specification. Calculate signal strength from sources to endpoints. Allowable losses between components and user interface shall be used to determine size and type of cable.
- E. Coordination Drawings: Include dimensioned plan and elevation views of components and enclosures. Show access and workspace requirements.
- F. Field quality-control reports.
- G. Operation and Maintenance Data: For headend and distribution system to include in emergency, operation, and maintenance manuals.

PART 2 – PRODUCTS

2.1 RADIO FREQUENCY (RF) BDA-BASED SIGNAL BOOSTER SYSTEMS

- A. Completed cabling installations must comply with all applicable codes and standards, including Owner Building and Electrical Codes, NFPA, ANSI, NEC, OSHA, EIA, IEEE, R-56, etc., as well

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as the FCC Rules and Regulations, as applicable. Equipment provided must be UL listed and FCC type accepted for this specific application. Compliance to codes and standards must extend to include proper grounding, bonding and surge.

- B. The proposed system will provide digital signal strength coverage over 95% area on each floor/level of the equipped building. Systems must provide a minimum digital and analog coverage of Circuit Merit (CM) 3, with a reliability factor of 95%. A Coverage Acceptance Test must be executed prior to final acceptance of an installed system. Coverage acceptance testing must be based on audio quality performance in evenly spaced test grids in the defined service areas. A minimum of 20 tests will be taken per floor/level. Total number of test grids will be determined by the Owner, based on the size of the space per floor/level.
- C. Provide uninterruptable power source(s) (UPS) capable of maintaining the system operational for a minimum of 90 minutes.
- D. During initial installation, each system shall be optimized to perform in accordance with the specifications set forth in the system design, manufacturer's specifications and FCC regulations. The contractor shall ensure that uplink and downlink levels are properly set and consistent with design expectations. The contractor shall further ensure that noise and spurious products are held within limits set forth in the system design, manufacturer's specifications and FCC regulations. Prior to system acceptance, for each active BDA, booster amplifier, etc., the contractor shall submit a Proof of Performance certification, that lists the design expectations, actual measurements, and if applicable, FCC specifications for the following parameters:
 - a. Worst case BDA uplink input level, in dBm.
 - b. Worst case BDA uplink output level, in dBm.
 - c. BDA downlink input level, in dBm.
 - d. BDA downlink output level, in dBm.
 - e. Noise and spurious products, BDA uplink output, in dBc.
 - f. Noise and spurious products, BDA downlink output, in dBc.
- E. The original Proof of Performance report must be submitted to project manager, and a copy of the Proof of Performance report must be affixed to its associated equipment.
- F. The system is designated for in-building use and must be designed and quoted as follows: Design and appearance will be of "finished" construction, i.e. must be concealed and/or unobtrusive. Surface raceway and/or exposed conduit installations will not be acceptable unless approved by the Owner in advance.
- G. Interface system to the fire alarm for NFPA-72

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Provide all cabling, conduit, pathways, and equipment for a complete signal booster system.
- B. Visually inspect outside antenna installation. Correct any issues found with the antenna mounting hardware, grounding system, or outside cabling.

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- C. Visually inspect inside BDA or booster amplifier equipment installation. Correct any issues found with RF cabling, electrical connection, or equipment mounting.
- D. Clean equipment fans, filters and other ventilation system components.
- E. Inspect and replace any defective indicator lights.
- F. Test UPS system performance for proper fallback to battery power and the duration of battery operation.
- G. Test fault reporting system for proper operation and reporting of system faults.
- H. Submit a written Preventive Maintenance Report to the Owner, listing the results of the optimization and preventive maintenance effort. The report shall include the Proof of Performance report for active RF components, and details of any other discrepancies found, and corrective actions taken.
- I. All as-built drawings shall be submitted to the Owner at completion, which shall include antenna system layout and all associated hardware, along with specification sheets. Include RF measurements taken.

3.2 WARRANTY

- A. The contractor must provide a full one-year warranty to cover installation and all components; the warranty must commence upon the Owner's final acceptance of the facility. Under warranty coverage, the successful contractor must provide same business day response time for system malfunctions.
- B. Test fault reporting system for proper operation and reporting of system faults.
- C. All as-builts will be submitted to the owner at completion, which shall include cable system layout, along with specification sheets.

END OF SECTION 27 64 10

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SECTION 280500 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

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. Electronic safety and security equipment coordination and installation.
 - 2. Sleeves for raceways and cables.
 - 3. Sleeve seals.
 - 4. Grout.
 - 5. Common electronic safety and security installation requirements.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For sleeve seals.

1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of electronic safety and security equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

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- C. Coordinate location of access panels and doors for electronic safety and security items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

1.6 QUALITY ASSURANCE

- A. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment".

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.

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2. Sealing Elements: interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
3. Pressure Plates: Include two for each sealing element.
4. Connecting Bolts and Nuts: Of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electronic safety and security equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRONIC SAFETY AND SECURITY PENETRATIONS

- A. Electronic safety and security penetrations occur when raceways, pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

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- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

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3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electronic safety and security installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 280500

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SECTION 280533 - RACEWAYS AND BOXES FOR DIVISION 28 SYSTEMS

PART 1 - GENERAL

1.1 APPLICATION

- A. This specification shall be used for all Division 28 work and supersedes any other direction or typical NEC application unless said application is more stringent than the information provide herein.

1.2 RELATED DOCUMENTS

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

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. RGS: Rigid Galvanized Steel conduit.
- C. FMC: Flexible metal conduit.
- D. IMC: Intermediate metal conduit.
- E. LFMC: Liquidtight flexible metal conduit.
- F. LFNC: Liquidtight flexible nonmetallic conduit.
- G. NBR: Acrylonitrile-butadiene rubber.
- H. RNC: Rigid nonmetallic conduit.
- I. PVC: Schedule 40 PVC
- J. ACCESSIBLE: Conduit less than 12' above the finished floor that is capable of being exposed without damaging the building structure or finish or not permanently closed in by the structure or finish of the building. Example: Conduit below 12' AFF that is above a removable ceiling tile is considered "Accessible"
- K. SECURE: Area in which inmates have supervised or non-supervised access on a routine or constant basis. Refer to Architectural drawings for the areas designated as secure. If not clearly defined, the space shall be deemed as secure.
- L. RACEWAY: An enclosed channel of metal or nonmetallic materials designed expressly for holding wires or cables. Raceways include, but are not limited to, rigid metal conduit, rigid

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nonmetallic conduit, intermediate metal conduit, liquidtight flexible conduit, flexible metallic tubing, flexible metal conduit, electrical nonmetallic tubing, and electrical metallic tubing.

1. Cables such as MC, AC, or Greenfield are NOT raceways.

1.4 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. Allied Tube & Conduit.
 2. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
 3. Robroy Industries.
 4. Thomas & Betts Corporation.
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. IMC: Comply with ANSI C80.6 and UL 1242.
- E. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
 1. Comply with NEMA RN 1.
 2. Coating Thickness: 0.040 inch, minimum.
- F. EMT: Comply with ANSI C80.3 and UL 797.
- G. FMC: Comply with UL 1; zinc-coated steel.
- H. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- I. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
 1. Fittings for EMT: Steel compression type.
 2. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
 3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

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- J. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Electri-Flex Company.
 - 3. RACO; Hubbell.
 - 4. Thomas & Betts Corporation.
- B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. PVC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2. Hoffman; a brand of Pentair Equipment Protection.
 - 3. Square D.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, unless otherwise indicated, and sized according to NFPA 70.
 - 1. Metal wireways installed outdoors shall be listed and labeled NEMA 3R, Flanged-and-gasketed type, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Screw-cover type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways shall be listed and labeled as defined in NFPA 70, and marked for intended location and application.

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- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect].
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. MonoSystems, Inc.
 - b. Panduit Corp.
 - c. Wiremold / Legrand.

2.5 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. EGS/Appleton Electric.
 2. Erickson Electrical Equipment Company.
 3. Hoffman; a brand of Pentair Equipment Protection.
 4. Hubbell Incorporated.
 5. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
 6. RACO; Hubbell.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy or aluminum, Type FD, with gasketed cover.
- E. Metal Floor Boxes:
1. Material: Cast metal.
 2. Shape: Rectangular.
 3. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum or galvanized, cast iron with gasketed cover.
- I. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

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- J. Gangable boxes are not prohibited.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed Conduit: GRC.
 2. Concealed Conduit, Aboveground: GRC.
 3. Concealed in Masonry: GRC or PVC grouted solid after installation. Convert to metallic conduit per this specification prior to exiting the wall above ground.
 4. Concealed in Poured Concrete Walls: GRC or PVC. Convert to metallic conduit per this specification prior to exiting the wall above ground.
 5. Underground Conduit: Type PVC, direct buried.
 6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 7. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R
- B. Indoors Secure Locations: Apply raceway products as specified below unless otherwise indicated:
1. Exposed, GRC.
 2. Concealed in Ceilings Above 12' and Interior Walls and Partitions: EMT.
 3. Concealed in Masonry: GRC or PVC grouted solid after installation. Convert to metallic conduit per this specification prior to exiting the wall above ground.
 4. Concealed in Poured Concrete Walls: GRC or PVC. Convert to metallic conduit per this specification prior to exiting the wall above ground.
 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 6. Damp or Wet Locations: GRC.
 7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
 8. Concealed in Ceilings below 12': GRC. [*AD4]
- C. Indoors Non-secure Locations: Apply raceway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
 2. Exposed and Subject to Physical Damage: GRC. Raceway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 4. Concealed in Masonry: GRC or PVC grouted solid after installation. Convert to metallic conduit per this specification prior to exiting the wall above ground.
 5. Concealed in Poured Concrete Walls: GRC or PVC. Convert to metallic conduit per this specification prior to exiting the wall above ground.

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6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 7. Damp or Wet Locations: GRC.
 8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- D. Minimum Raceway Size: 3/4-inch trade size.
- E. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
Concealed conduit to the greatest extent possible. For all exposed and accessible conduit within the secure perimeter, provide RGS, IMC unless otherwise noted on the drawings. Refer to Architectural drawings for secure perimeter.
- F. AC is not acceptable in any application.
- G. Do not install aluminum conduits, boxes, or fittings.
- H. Install surface raceways only where indicated on Drawings.
- I. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. All conduit shall be tight to the structure and secured with two-hole steel conduit straps. Unless indicated otherwise on the drawings, for all exposed or accessible conduit inside the secure perimeter, the distance between supports shall be one half that specified by NEC. (twice as many supports as required by NEC).
- C. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- D. Complete raceway installation before starting conductor installation.

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- E. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- F. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- G. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- H. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- I. All conduit to be installed on exterior masonry shall not run continuously within the wall cavity.
- J. Support conduit within 6 inches of enclosures to which attached.
- K. Raceways Embedded in Slabs are not permitted, except as required for entry into recessed floor boxes. Conduits shall be routed below the slab within the porous fill and stub-up at the required location. Transition from PVC to RGS with RGS elbow before rising above the floor. After RGS elbow, stub-up conduit shall be type indicated in Part 3.1 above. PVC shall not be permitted exposed above the floor.
- L. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.
- M. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
- N. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for raceways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- O. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- P. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- Q. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- R. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

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- S. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- T. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- U. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- V. Special Fittings and Installations:
 - 1. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
 - 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.
 - 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
 - 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- W. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 - 1. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- X. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements and also refer to Architectural elevations. Install boxes with height measured to center of box unless otherwise indicated.
- Y. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box. Retain the fire rating of any fire rated wall or assembly.
- Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

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- AA. Locate boxes so that cover or plate will not span different building finishes.
- BB. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- CC. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- DD. Set metal floor boxes level and flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom for pipe less than 6 inches in nominal diameter.
2. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
3. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
 - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
4. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 BOX AND CONDUIT COLOR CODING

- A. Refer to Division 26 "Raceways and Boxes for Electrical Systems."

3.5 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Maintain the fire rating of all fire rated walls and assemblies in which electrical raceway or boxes are installed.

END OF SECTION 270533

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SECTION 283111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

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 but is not limited to:

1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. Smoke detectors.
4. Duct smoke detectors.
5. Heat detectors.
6. Notification appliances.
7. Device protective covers.
8. Fire alarm extender panels.
9. Magnetic door holders.
10. Remote annunciators.
11. Addressable interface devices.
12. Digital alarm communicator transmitter.
13. System printer.
14. Extra materials.

- B. Fire alarm system shall monitor the status of the BDA-Signal Booster Systems. Provide a minimum of eight monitor points at the control panel. Mark un-used points as spare. Refer to specification 276410 for additional detail.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. NICET: National Institute for Certification in Engineering Technologies.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product, including furnished options and accessories.
 1. Include construction details, material descriptions, dimensions, profiles, and finishes.
 2. Include rated capacities, operating characteristics, and electrical characteristics.

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3. Provide UL file numbers documenting UL listing for purpose for every component of the system.
- B. Shop Drawings: For fire-alarm system.
1. Include plans, elevations, sections, details, and attachments to other work.
 2. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
 3. Include voltage drop calculations for notification appliance circuits (NAC). Load visual NAC's to a maximum of 60% capacity to allow for additional devices or resetting candela output of devices provided.
 4. Include battery-size calculations. Load batteries to a maximum of 60% capacity to allow for additional devices or resetting candela output of devices provided.
 5. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 6. Include 1/8" = 1'-0" scale floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.
 7. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
 8. Detail assembly and support requirements.
 9. Include input/output matrix.
 10. Include performance parameters and installation details for each detector.
 11. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 12. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' smoke-evacuation system.
- C. System Operation Description: Detailed description for this Project, including method of operation and supervision of each type of circuit and sequence of operations for manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: For fire-alarm systems and components 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. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
 2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
 3. Provide "As-Built" prints and PDF format copies of layout floor plans indicating all field revisions since shop drawing submittals. Updated prints shall have been made in CAD, not hand markups. Provide disk with AutoCAD compatible plans of As-Built plans.
 4. Record copy of site-specific software.
 5. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:

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- a. Frequency of testing of installed components.
 - b. Frequency of inspection of installed components.
 - c. Requirements and recommendations related to results of maintenance.
 - d. Manufacturer's user training manuals.
 6. Manufacturer's required maintenance related to system warranty requirements.
 7. Abbreviated operating instructions for mounting at fire-alarm control unit.
 8. Copy of NFPA 25.
 9. Device address list including plain text descriptions/locations, room names and numbers coordinated with Owner's actual designations, not necessarily those on the Contract Documents.
 10. Warranty: Signed copy of warranty and software agreement..
- 1.5 A documentation cabinet shall be installed at the system control unit or at another approved location at the protected premises for storage of all record documentation. Where the documentation cabinet is not in the same location as the system control unit, its location shall be identified at the system control unit. The documentation cabinet shall be prominently labeled SYSTEM RECORD DOCUMENTS. (2013 NFPA 72 National Fire Alarm and Signaling Code Section 7.7.2).
- 1.6 QUALITY ASSURANCE
- A. Installer Qualifications:
 1. Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
 2. Installation shall be supervised by personnel certified by NICET as fire-alarm Level III technician.
 - B. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer.
 - C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 1. Fire Alarm Systems and components performing release service shall be listed and labeled for that purpose.
 2. Fire Alarm System and components that are part of the Smoke Control System shall be listed and labeled per UL864 classification UUKL.
- 1.7 SOFTWARE SERVICE AGREEMENT
- A. Comply with UL 864.
 - B. Technical Support: Beginning with Final Acceptance, provide software support for one year.
 - C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within year from date of Final Acceptance. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

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1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.8 EXTRA MATERIALS

- A. Provide extra materials described below that match products installed including installation. Uninstalled devices shall be packaged with protective covering for storage, identified with labels describing contents and turned over to the owner at the completion of the project.
 1. Fuses (If Used) 2 of each size in system
 2. Manual Fire Alarm Boxes.....2% of installed quantity
 3. Addressable Control Relays.....4% of installed quantity
 4. Indoor Horns/Speakers with Strobes Lights.....4% of installed quantity
 5. Indoor Strobe-only Notification Appliances.....4% of installed quantity
 6. Monitor Modules (Addressable Interface) 4% of installed quantity
 7. Isolation Modules / Isolation Bases.....4% of installed quantity
 8. Addressable, Electronic Heat Detectors.....4% of installed quantity
 9. Spot-Type Smoke Detectors / Sounder Bases.....6% of installed quantity
 10. No spares are required for projected beam, air sampling, or duct smoke detectors
- B. Contractor shall itemize Extra Materials material and labor on the project Schedule of Values.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: **Five** years from date of Final Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work are not limited to the following:
 1. Gamewell; a Honeywell company.
 2. Notifier; a Honeywell company.
 3. Simplex – Johnson Controls
- B. SUBSTITUTION REQUESTS
 1. Substitution packages shall be submitted to Architect no later than fifteen days (15) prior to bid for review and approval.
 2. Provide data requested SUBMITTALS -Product Data above

2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:

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1. Manual stations.
2. Heat detectors.
3. Smoke detectors.
4. Duct smoke detectors.
5. Automatic sprinkler system water flow.
6. Preaction system. (if present)

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.
2. Identify alarm at fire-alarm control unit and remote annunciators.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Unlock electric door locks in designated egress paths.
5. Release fire and smoke doors held open by magnetic door holders.
6. Deactivate designated heating, ventilating, and air-conditioning equipment.
7. Close smoke dampers in air ducts of designated air-conditioning duct systems.
8. Activate smoke control system(s).
9. Record events in the system memory.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. High- or low-air-pressure switch of a dry-pipe or preaction sprinkler system (if present).
3. User disabling of zones or individual devices.
4. Loss of communication with any panel on the network.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at fire-alarm control unit.
4. Ground or a single break in fire-alarm control unit internal circuits.
5. Abnormal ac voltage at fire-alarm control unit.
6. Break in standby battery circuitry.
7. Failure of battery charging.
8. Abnormal position of any switch at fire-alarm control unit or annunciator.
9. Fire-pump power failure, including a dead-phase or phase-reversal condition.
10. Low-air-pressure switch operation on a dry-pipe or preaction sprinkler system.

E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators. Record the event on system printer.

2.3 FIRE-ALARM CONTROL UNIT

A. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.

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- a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
 - b. Include a real-time clock for time annotation of events on the event recorder and printer.
 2. Addressable initiation devices that communicate device identity and status.
 - a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at fire-alarm control unit.
 - b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.
 3. Addressable control circuits for operation of mechanical equipment.
- B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
 1. Annunciator and Display: Liquid-crystal type, 2 line(s) of 80 characters, minimum.
 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.
- C. Circuits:
 1. Initiation Device Circuits (IDC) to be wired Class A (NFPA 72 Style D) and Alarm Notification Appliance (NAC) circuits to be Class A (NFPA 72 Style Y). Signal Line Circuits (SLC), also called addressable loop - alarm, trouble and supervisory signals from all intelligent reporting devices, shall be encoded onto a Class 6 (NFPA 72 Style 6) with no "T" taps.
- D. Smoke-Alarm Verification:
 1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
 2. Activate an NRTL-listed and -approved "alarm-verification" sequence at fire-alarm control unit and detector.
 3. Record events by the system printer.
 4. Sound general alarm if the alarm is verified.
 5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.
- E. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke barrier walls shall be connected to fire-alarm system.
- F. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-

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adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

- G. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.
- H. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.
 - 1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.
- I. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
 - 1. Batteries: Sealed lead calcium or Vented, wet-cell pocket, plate nickel cadmium. Minimum battery capacity compliant of 60 hours battery power capacity, plus 5/15 minutes of full alarm load. Proprietary and other systems require 24 hours capacity plus 5/15 minutes alarm load.
- J. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 FIRE ALARM EXTENDER PANELS (FNAC)

- A. FNAC's contain power supplies, batteries and notification appliance circuit cards to drive notification appliances, for systems too large to be driven directly from the FACP. Also referred to as Booster Power Supply.
- B. FNAC Listed and labeled per UL classification UOXX or UOJZ as a component of the fire alarm system.
- C. Cabinet: Lockable steel enclosure. Arrange interior components so operations required for testing or for normal maintenance of the system are performed from the front of the enclosure. If more than one unit is required to form a complete control panel, fabricate with matching modular unit enclosure to accommodate components and to allow ample gutter space for field wiring and interconnecting panels.
- D. Signaling line circuit between FACP and FNAC shall be supervised.

2.5 MANUAL PULL STATIONS

- A. Description: Fabricated of plastic, and finished in red with molded, raised-letter operating instructions of contrasting color.
 - 1. Double-action mechanism requires two actions, such as a push and a pull, to initiate an alarm.

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2. Station Reset: Key or wrench operated; double pole, double throw; switch rated for the voltage and current at which it operates.
3. Integral Addressable Module: Arranged to communicate manual-station status (normal, alarm, or trouble) to the FACP.
4. Pullstations shall be key operated in inmate accessible areas.

2.6 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be two-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.
7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
 - a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
 - b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).
 - c. Provide multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.

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2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).
3. Environmental compensation, programmable sensitivity settings, status testing, and monitoring of sensor dirt accumulation for the duct smoke sensor shall be provided by the FACP.
4. The Duct Housing shall provide a supervised relay driver circuit for driving up to 15 relays with a single "Form C" contact rated at 7A@ 28VDC or 10A@ 120VAC. This auxiliary relay output shall be fully programmable (controlled by the FACP, not by the detector itself). Relay shall be mounted within 3 feet of HVAC control circuit.
5. Duct Housing shall provide a relay control trouble indicator Yellow LED.
6. Duct Housing shall have a transparent cover to monitor for the presence of smoke. Cover shall secure to housing by means of four (4) captive fastening screws.
7. Duct Housing shall provide two (2) Test Ports for measuring airflow and for testing. These ports will allow aerosol injection in order to test the activation of the duct smoke sensor.
8. For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them through the duct housing front cover.
9. Each duct smoke sensor shall have a Remote Test Station with an alarm LED and test switch. If the station is not located directly below the detector, provide permanent signage at the station indicating detector location.
10. Where located outdoors, provide NEMA 4X weatherproof duct housing enclosure that shall provide for the circulation of conditioned air around the internally mounted addressable duct sensor housing to maintain the sensor housing at its rated temperature range. The housing shall be UL Listed to Standard 268A.

2.7 HEAT DETECTORS

- A. General Requirements for Heat Detectors: Comply with UL 521.
- B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C)] per minute unless otherwise indicated.
 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.8 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, equipped for mounting as indicated and with screw terminals for system connections.

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1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.
- B. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.
- C. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.
- D. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.
 1. Rated Light Output:
 - a. 15/30/75/110 cd, selectable in the field.
 2. Mounting: Wall mounted unless otherwise indicated.
 3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
 4. Flashing shall be in a temporal pattern, synchronized with other units.
 5. Strobe Leads: Factory connected to screw terminals.
 6. Mounting Faceplate: Factory finished, white.

2.9 MAGNETIC DOOR HOLDERS

- A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.
 1. Electromagnet: Requires no more than 3 W to develop 25-lbf (111-N) holding force.
 2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
 3. Rating: 24V powered from the fire alarm system.
 4. Provide a monitor and/or releasing module as required
- B. Material and Finish: Match door hardware.

2.10 ADDRESSABLE INTERFACE DEVICES

- A. Monitor Module: Microelectronic monitor module listed for use in providing a multiplex system address for listed fire and sprinkler alarm-initiating devices with normally open contacts.
- B. Control Module: Microelectronic control module listed for use in providing a multiplex system address with normally open and normally closed contacts. Used to interface operation with non-system devices and equipment such as dampers, starters, and relays.

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2.11 FIRE ALARM ANNUNCIATOR PANEL

- A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
 - 1. Mounting: Flush cabinet, NEMA 250, Type 1.
- B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.12 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.
- B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit shall automatically dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either transmission method (see below) is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of transmission to the remote alarm receiving station over the remaining line. Transmitter shall automatically report transmission restoration to the central station. If service is lost on both transmission methods, transmitter shall initiate the local trouble signal.
- C. The communication methods used to transmit signals to the remote supervising station shall meet the requirements of NFPA 72 National Fire Alarm and Signaling Code
 - 1. Provide a DACT (Digital Alarm Communicator Transmitter) using a standard telephone (POTS) as the primary means of communication.
 - 2. Provide an IP DACT (Internet Provider Digital Alarm Communicator Transmitter) using an owner provide IP telephone (VoIP) as the alternative transmission and/or redundant, secondary path
- D. Local functions and display at the digital alarm communicator transmitter shall include the following:
 - 1. Verification that both telephone lines are available.
 - 2. Programming device.
 - 3. LED display.
 - 4. Manual test report function and manual transmission clear indication.
 - 5. Communications failure with the central station or fire-alarm control unit.
- E. Digital data transmission shall include the following:
 - 1. Address of the alarm-initiating device.
 - 2. Address of the supervisory signal.
 - 3. Address of the trouble-initiating device.

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4. Loss of ac supply or loss of power.
5. Low battery.
6. Abnormal test signal.
7. Communication bus failure.

F. Secondary Power: Integral rechargeable battery and automatic charger.

G. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.13 GUARDS FOR PHYSICAL PROTECTION

A. Inmate accessible areas

1. Smoke detector guard shall be a model permitted by the smoke detector manufacturer's installation instructions and listing. Construction shall be 16-gauge steel with powder coat enamel finish.
2. Visual and Audio/Visual Notification Appliances guard shall be a model permitted by the appliance manufacturer's installation instructions and listing. Construction shall be 16-gauge steel with powder coat enamel finish.

2.14 TRANSIENT PROTECTION

- A. Provide transient protectors for conductors (including conductive fiber cable, if present) entering each building from the outside, in accordance with NFPA-70, Article 800, and as recommended by the manufacturer for the type of line being protected.

2.15 FIRE ALARM WIRE AND CABLE

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

1. Comtran Corp.
2. Draka USA.
3. Genesis Cable Products; Honeywell International, Inc.
4. Rockbestos-Suprenant Cable Corporation.
5. West Penn Wire/CDT; a division of Cable Design Technologies.

- B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

- C. Signaling Line Circuits: Twisted, shielded pair, size as recommended by system manufacturer.

- D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.

1. Low-Voltage Circuits: No. 16 AWG, minimum.
2. Line-Voltage Circuits: No. 12 AWG, minimum.

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- E. All fire alarm circuitry shall be run in conduit in accordance with Section 260533 "Raceways and Boxes."

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72 for installation of fire-alarm equipment.
- B. Equipment Mounting: Install fire-alarm control unit with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.
 - 1. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Smoke- or Heat-Detector Spacing:
 - 1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
 - 2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
 - 3. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A [or Appendix B] in NFPA 72.
 - 4. HVAC: Locate detectors not closer than [3 feet (1 m)] [5 feet (1.5 m)] from air-supply diffuser or return-air opening.
- D. Duct Smoke Detectors: Comply with manufacturer's written instructions.
 - 1. Furnish duct smoke detectors and instructions for installation to the contractor performing work under Division 23.
 - 2. Verify that each unit is listed for the complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 - 3. After installation by Div 23, verify devices are installed in accordance with the manufacturer's instructions.
 - 4. Provide circuitry and connections.
- E. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.
- F. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
- G. Visible Alarm-Indicating Devices: Install at least 6 inches (150 mm) below the ceiling.
- H. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- I. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

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- J. Graphic Annunciator: Install with top of panel not more than 72 inches (1830 mm) above the finished floor.
- K. Text Annunciator: Install with top of panel not more than 46 inches (1830 mm) above the finished floor.

3.2 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 Section "Door Hardware." Connect hardware and devices to fire-alarm system.
 - 1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet (1 m) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
 - 1. Smoke dampers in air ducts of designated air-conditioning duct systems.
 - 2. Alarm-initiating connection to activate emergency lighting control.
 - 3. Supervisory connections at valve supervisory switches.
 - 4. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
 - 5. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.
 - 6. Supervisory connections at fire-pump engine control panel.

3.3 WIRING INSTALLATION

- A. Wiring Method: Install wiring in metal raceway according to Division 26 Section "Raceways and Boxes." And Division 28 Section "Raceways and Boxes for Div 28 Systems." Conceal raceway except in unfinished spaces and as indicated.
- B. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by the manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- C. Cable Taps: Taps are specifically prohibit other than at device terminal blocks, or on terminal blocks in cabinets Use numbered terminal strips in cabinets or equipment enclosures where circuit connections are made.
- D. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Alarm circuit, supervisory circuits, normal power wiring, audible alarm-indicating devices, and visible alarm-indicating devices shall have different color coded wiring.

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3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.

3.5 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.6 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by authorities having jurisdiction.
- 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. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
 - b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
 - 2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
 - 3. Smoke control inspection and testing shall be performed per the NC Building Code (2018 Ed.) Section 909.18.8.
 - 4. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
 - 5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
 - 6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
 - 7. Test smoke control system for operation per the Contractor-submitted control sequence, and per the requirements of NCBC 909.18, including but not limited to "Special Inspections."

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8. Testing shall include but not be limited to the following
 - a. Initiate one or more smoke detectors in the space using an approved method such as a smoke canaster.
 - b. Monitor the dampers, and units associate with the smoke zone and provide a written log that each device operated per the Fire Matrix on the drawings and that each device returned to its normal state after the test.
 - c. Test each control switch and AHU switch on the smoke control panel in each position. and provide a written log that each device operated correctly, and that each device returned to its normal state after the test. Place all switches back in automatic position after the test.

D. Fire-alarm system will be considered defective if it does not pass tests and inspections. Take corrective action and retest until accepted by the AHJ.

E. Prepare test and inspection reports.

F. Annual Test and Inspection: One year after date of Final Acceptance, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system. Schedule training in 2 sessions at the Owner's convenience.

END OF SECTION 283111

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SECTION 285000 - SECURITY CONTROL SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this section.

1.2 DESCRIPTION OF WORK

- A. The general contractor shall contract the services of a qualified Security Controls System Contractor (SCSC) and shall be responsible for the Security Controls System Contractor (SCSC) and the systems they shall provide as part of the Division 28 specification sections.
- B. All Work associated with a complete and fully functional Security Control System shall be provided by the Security Controls System Contractor (SCSC). This Work and system shall include, but may not be limited to, all conduit, raceway, wire, terminations, backboxes, devices, equipment, products, services, and overall systems integration. The installation or furnishing of such Work by other trades, including the Electrical Subcontractor, shall not be acceptable unless they are a direct subcontractor to the SCSC.
- C. The SCSC shall provide all equipment, shop drawing submittals, testing reports, and samples as described in Specification Sections 285000, 285010, 285020, 285030, 285100, 285200, 285260, 285300, 285400, 285500, and 285900.
- D. The SCSC shall provide a software data flow diagram/chart indicating in what programs and where all control logic will reside. Provide a detailed description of software solution and all secondary software or drivers used to interface or integrate all the security systems. All computers listed throughout the security control system in specification sections 285000 – 285900 shall use Windows 11 or better operating system. All servers listed throughout the Security Control System specification sections 285000 – 285900 shall use Windows Server 2022 or better.
- E. All software shall be readily available through conventional sources and all programming shall be written utilizing language simplistic enough to be modified in the future by Owner's qualified staff or a third party integrator. If it is found the SCSC provided non-modifiable programming language or encrypted software but did not disclose this information, the system shall be completely redeveloped with modifiable programming methods at the SCSC's expense.
- F. The SCSC shall turn over to the Owner all programming passwords, source codes and programming schedules at Substantial Completion. Prior to final payment, the SCSC shall provide all software, licenses, information, training, and any other items needed to allow the Owner to make future modifications to programming utilizing options other than the original SCSC.
- G. Summary
 - 1. The SCSC shall be responsible for coordinating with Division 8, Division 11, and Division 26, the power and cabling requirements of all electric strikes, electric locks, door position indicators, or any other device associated with and controlled/monitored by the Security Control System. This coordination includes the identification and resolution of potential conflicts in the scope of work between these Divisions.
 - 2. Types of Security Control System components/features/interfaces:
 - a. The SCSC shall be responsible for all Division 28 field device installation, terminations, and equipment configuration.

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- b. Provide a complete fully functional Security Control System.
- c. Provide all conduit, raceway, wire, terminations, backboxes, and equipment for a complete system. All security cabling shall be in conduit the entire distance of the run unless otherwise noted.
- d. Provide proper control of detention hardware as supplied by Division 11 and security hardware as supplied by Division 8. Coordinate all architectural doors with security devices to ensure proper lock, lock power, and control wiring to these locations.
- e. Provide all necessary distributed AC/DC system power, unless otherwise noted.
- f. The complete Security Control System shall be connected through UPS power and generator power.
 - 1) Provide interface with UPS to VGUI system for annunciation of UPS trouble alarms on the VGUI.
 - 2) Provide interface with emergency generator to VGUI system for annunciation of generator trouble alarms on the VGUI.
- g. Prior to fabrication, coordinate exact location and installation of Security Control System with other trades.
- h. Provide complete system test and written operational certification to the Architect/Engineer and Owner prior to substantial completion.
- i. Provide Owner training by factory-trained and authorized personnel as specified.
- j. Turn over to Owner all termination point and interconnection schedules, all programming source codes including VGUI software, PLC development software, VMS software, VMS viewing software, video system software and applicable license required for operations. This is to also include the VGUI and security management system and runtime licenses.
- k. Flat VGUI panel Control Consoles to integrate the controlling and monitoring of all doors, alarms, video, intercoms, card access and other designated device annunciations. VGUI Control shall have the ability to monitor all security devices and components throughout the entire facility during normal operations.
- l. Audio Communications system.
- m. Provide IP based color video System with network video recording.
- n. Provide Video Client workstations as indicated on the drawings.
- o. Provide cameras, lenses, housings and accessories for interior and exterior applications.
- p. Provide complete Access Control System and interface with indicated architectural doors, barrier arm gates and pedestrian gates for remote control and/or monitoring. Coordinate with the Owner to ensure the Access Control System provided under this contract can use all types of cards and credentials currently being used by the Owner. Provide interface with existing access control system.
- q. Provide all furniture-mounted and wall-mounted duress alarms
- r. Provide Security System Interface, cabling & connection for remote warranty troubleshooting and maintenance.
- s. Interface to plumbing system for water shutoff in holding areas and housing unit cells via VGUI control.
- t. Interface to lighting control for holding areas, cells and housing units via VGUI control.
- u. Provide Talk-thru Units (TTU) and Talk-thru Communicators (TTC).
- v. Coordinate all lighting pole mounted camera locations with Division 26. Coordinate conduit, wiring, and termination responsibility.
- w. Provide all spare components as specified.

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- x. Other controls, annunciation & monitoring indicated in the Division 285xxx specification sections and on the Drawings.
- H. Electrical Contractor: (SCSC shall coordinate with EC & GC)
 - 1. Coordinate all electrical requirements with both the SCSC and General Contractor.
 - 2. The Division 26 contractor shall be responsible for the coordination of conduits/cable raceways of architectural door frames with security hardware provided by Division 8. The SCSC shall be responsible for coordinating with Division 8, Division 11, and Division 26, for the power and cabling requirements of all electric strikes, locks, door position switches, or any other device associated and controlled/monitored by the Security Control System.
 - 3. Provide termination of all 120-volt power connections required by the Security Control System for the computer and monitoring equipment at various security control stations.
 - 4. Lighting and Receptacle control relays and terminations shall be done by the electrical contractor. SCSC to coordinate interface to relays and termination of outputs.
 - 5. Provide all 120V power connections from emergency/generator power panels.
 - 6. Coordinate with the SCSC and provide 120V power for:
 - a. At the vehicle drive up card reader / intercom / camera post
 - b. At all power supplies in hardware sets for architectural doors, as listed in Specification Section 087100 – Door Hardware.
- I. General Contractor: (SCSC shall coordinate and make the GC aware of these requirements)
 - 1. Coordinate the inter-related work of the SCSC, Div. 11, Div. 8, millwork provider, and Div. 26 Contractors.
 - 2. Include detailed scheduling information for Security Control System installation and testing in the construction schedule. Provide the SCSC two months of testing and troubleshooting of the installation of his equipment near the end of the project. When the system is completely installed, provide the SCSC free access and total control with no other construction traffic for a period of two weeks for proper testing and certification of the system.
 - 3. Provide coordination to ensure that control rooms and Security Electronics rooms are completed as early as possible to facilitate installation of control wiring. Control room(s) and Security Electronics equipment room(s) shall be free of airborne contaminants from cutting, grinding, painting, masonry work, etc., prior to the installation of any Security Electronics equipment. HVAC system must be started and running at a temperature and humidity level required for the operation of the equipment in the spaces.
 - 4. Conduct periodic coordination meetings between security, electrical, plumbing, masonry and all other contractors to make everyone aware of critical areas of construction. Distribute the meeting minutes and attendance to the Architect/Engineer and Owner.
 - 5. Provide coordination with the SCSC to complete the inspections, submittal and closeout documentation as described in the general provisions.
- J. Detention Equipment Contractor (DEC):
 - 1. Coordinate with the General Contractor, Electrical Contractor and SCSC.
 - 2. Furnish, install, and terminate detention hardware.
 - 3. Provide all the necessary and proper adjustments for correct hardware operation.

1.3 QUALITY ASSURANCE

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- A. Work shall be in accordance with the applicable federal, state, and local codes or standards current at the commencement of installation. Where more than one code or regulation is applicable, the more stringent shall apply. All Security Contractor Licensing requirements for contractors and subcontractors shall be enforced as per applicable codes and statutes (refer to the North Carolina Department of Public Safety; www.ncdps.gov).
- B. Cable installation, identification and termination shall be performed in accordance with the Manufacturer's technical installation guidance, in addition to the applicable codes and statutes.
- C. All conduit within the secure perimeter shall be concealed when possible. If exposed, all conduit shall be mounted as close to ceiling as possible. Conduit, backboxes, and devices shall be mounted tight to the surface utilizing tamper resistant security screws.
- D. All screws and fasteners for the new equipment within the security perimeter shall be tamper resistant security screws, requiring a special tool.
- E. In the absence of the Manufacturer's recommendations on conductor applications, the Security Control Systems Contractor (SCSC) shall ensure that the cabling selected meets all technical requirements of the equipment to be installed.
- F. An SCSC is required for this project. It is critical that the SCSC understands and meets the requirements of the Contract Documents, the equipment specified and security control systems integration. And, that the equipment is properly installed and functionally ready for use at time of completion specified for the facilities.
- G. Division and separation of total responsibility for contract delivery of the security control systems will not be acceptable.
- H. The SCSC shall be able to respond on site with qualified personnel to emergency service within 12 hours of notification.
- I. The SCSC shall be responsible for providing a complete security control system. This shall include but not be limited to, cabling, cabling raceways, terminations of all system cabling, all distributed AC and/or DC power, field devices and control components, systems start-up, acceptance testing, training, and the complete and total integration of all systems utilizing 'In-House' software programming expertise.
- J. Available Security Control System Contractors (SCSC):
 - 1. Accurate Controls Inc. – Ripon, WI
 - 2. Cornerstone – Madison, AL
 - 3. Esitech Inc. – Richmond, VA
 - 4. Johnson Controls – Montgomery, AL
 - 5. Securitas, Noblesville, IN
 - 6. South Western Communications – Decatur, AL
- K. It is not, however, the intent of the Owner or Architect to unfairly restrict competition. Other equally competent SCSCs who meet the 'qualification criteria' specified herein shall be added to the list of 'Available Security Control System Contractors (SCSC)' by addendum. Verbal approval will not satisfy this requirement. Grounds for disqualification shall exist if, in the opinion of the Architect, the information submitted is inaccurate or does not comply with the requirements of this specification. There will be no exceptions. All competent non-listed SCSCs may request to be listed by submitting the data requested in the paragraph 'Qualification Criteria for the SCSC', a minimum of fifteen (15) days prior to bid receipt date. If the bid date is extended for any reason, the qualification period will not be extended.

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L. Qualification Criteria for the SCSC

1. Contractor Qualification Statement AIA–A305 shall be filled out in its entirety. Some of the additional criteria in this section may have similar requirements as those found in the A305 form, but such similarities shall not create an exemption to answer the questions on the A305 form.
2. The SCSC shall have been actively engaged in the design and delivery of electronics security control system solutions. Provide a historical narrative of the company from inception; including history of ownership, partnership, incorporation and/or other organizational information. Include information on the growth of the firm over time to include number of employees, relocation(s) of the firm, mergers and acquisitions. Use only the current corporate/business entity, intending on bidding and performing the work.
3. Provide documentation of experience. List two (2) projects completed in the last 10 years for the state in which this project is located. Out of state experience will not be considered. List only projects with cost of security electronics portion in excess of \$165,000 and of similar scope. Documentation is to include project names, addresses, description of systems, and the names, addresses, telephone numbers, and contact persons of the contractor and/or owner for whom the work was done.
4. Provide statement that firm has been in business for minimum of five continuous years under the current name.
5. Provide a resume of all key employees in supervisory positions; include their current position, time of service in current position, years as a full-time employee of the SCSC, and number of years of experience in the corrections and criminal justice markets.
6. Submit a block diagram of two previous projects which are similar in scope outlining all major and minor system components within the security control system as well as related systems, describing the integration of both hardware and software required for the complete system.
7. List of projects currently under construction including project size, scope and location.
8. Submit a listing of all jobs which the SCSC is presently or has been involved in litigation and the status thereof.
9. Provide a list of all jobs where your firm has been involved in liquidated damages or where delay damages were filed against your firm.
10. Submit a current letter from the proposed security control system equipment manufacturer's stating that the SCSC is factory trained, fully authorized distributor and installer of their complete line of products.
11. Provide signed statement that SCSC has not been found guilty of charges relating to conflicts of interest or to any criminal activity relating to construction methods, bidding, bid rigging, or bribery in the past five years.
12. Provide signed statement that SCSC has not been found guilty of charges relating to employment of illegal aliens on construction projects in the past five years.
13. Provide a letter from 'A' rated surety company that your company will be able to provide a Performance/Payment bond for this project if awarded the project.
14. The SCSC shall have sufficient financial ability to perform the contract that would result from such procurement. If a bond is required to ensure performance of a contract, evidence that the Contractor can acquire a surety bond from a corporation included on the United States Treasury list of acceptable surety corporations in the amount and type re-

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quired by the public body shall be sufficient to establish the financial ability of such SCSC to perform the contract resulting from such procurement.

15. Name, address and telephone number of organization's current Bonding Company and level of bonding capacity.
16. The SCSC shall indicate complete and total compliance with the provisions of this specification by letter signed by an officer of the corporation or a principal if other ownership currently exists.
17. Provide the security control system contractor's license number.

1.4 SECURITY CONTROL SYSTEM TRAINING

- A. Provide supervisory, operational, and maintenance training outlines and training materials thirty (30) days prior to training.
- B. Provide complete supervisory and operator training for the Owner's personnel at the end of construction.
 1. Provide three (3) eight-hour sessions on consecutive days at times set by the Owner. This may include 2nd and 3rd shift times to accommodate all officers. These should be scheduled as part of the Owner's pre-occupancy transition training.
 2. Provide one (1) eight-hour session at a time set by the Owner for maintenance training of the system.
- C. Provide an interactive training DVD's for all system operations and system troubleshooting. Provide system operations and system troubleshooting training on separate DVD's. Provide two copies of each.
 1. This DVD shall be carefully organized and segmented so that training may be given on the complete system or on specific functions as may be appropriate.
 2. The DVD shall contain computer-generated screen animation with narration describing icon selection, graphic animation and operation.
 3. The maintenance portion of this DVD shall contain still images with graphics and narration describing all equipment states and troubleshooting methods including LED indication and text read out.

1.5 SUBMITTALS

- A. The SCSC shall submit four (4) submittals for this project. Each submittal shall contain all the necessary criteria for all Div. 285xxx sections, and for each subsequent re-submittal if necessary. Submittals 1 (Product Data) and 2 (Shop Drawings) shall be submitted at the same time. Following this process will afford the submitted information to be reviewed more efficiently. All the necessary information the reviewer needs to properly evaluate the submission will be in the package each and every time it has to be reviewed. Failure to follow these submission requirements shall constitute the submittal(s) as being non-compliant and will be returned as "Rejected/Resubmit".
- B. It shall be the responsibility of the Architect and OWNER to completely review and approve all details of the VGUI control console screens prior to release for final software production. Any applicable changes made prior to release for software production shall be made at no cost to the Owner. (Refer to Part 3 - Execution, paragraph 'Software Supports'.)
- C. The submittal packages shall consist of one (1) reproducible (digital format) copy for each of the four (4) submittal types listed below. Each of the submittal types listed below shall include

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information from all the Div. 285XXX sections, as stated in paragraph A above. Provide electronic bookmarks, hyperlinks and divider pages to help navigate to and within the documents. Bookmarks and divisions shall match what is provided in the submittal's table of contents.

1. Product Data:
 - a. Provide Title Page and Table of Contents. Organize document by spec sections as listed in the Project Manual. Provide electronic bookmarks and divider pages to allow reviewer to navigate to spec sections and the different items within each section.
 - b. A Bill of Materials for each system, which shall include manufacturer names, model numbers, and quantities of all equipment proposed. It is acceptable to combine the Bill of Materials with the Table of Contents or section headings, provided all the required information is provided.
 - c. Technical product information clearly marked to identify the principal component(s) proposed. Information shall be listed in same order as presented in Table of Contents.
 - d. Specifications information for each type of cable required (power and data) and its application.
 - e. Markings: Submit for approval the SCSC's proposed wire marking, panel label, zone label, terminal strip numbering & terminal strip identification styles and typical text as outlined.
 - f. Shall be submitted at same time as Shop Drawings Submittal.
2. Shop Drawings:
 - a. All drawings shall be computer-generated for expedient modifications if required. At completion of the project, these drawings, along with any field changes, shall become part of the Contract Documents. Refer to paragraph titled "Record Drawings" ahead.
 - b. Building Floor Plan / Device Layout drawings: These drawings shall indicate the accurate locations of all equipment associated with each system in respect to architectural and structural conditions. Size drawings of components, equipment layouts and other small size areas to the common scale of 1/8", 1/2" or 1" per foot. Size drawings of larger areas to the common scale of 1/4" or 1/8" per foot. Drawings shall include explicit notes on the termination of all conductors and shields for each location. Architectural backgrounds shall be in accordance with the latest architectural drawings and shall be complete with elevations, sections, and details as required to depict the installation. These drawings shall be approved prior to starting work.
 - c. Equipment Room Layout Floor Plans:
 - 1) Scaled plan drawings indicating the placement of all required security control system components/racks and their relationship with all other adjacent objects.
 - 2) Indicate clearance and maintenance access requirements, and confirm all necessary clearances around components for both installation and maintenance have been coordinated.
 - 3) Dimension the location of and provide installation details of the security control system's 'Head-End' racks, including mounting and anchorage provisions.
 - 4) Provide elevations of each rack indicating the location of all equipment and components.

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- d. Control Room Enlarged Floor Plans and Elevations: Provide detail drawings depicting the plan location and elevation of all equipment to be provided within each security control room.
 - e. Block Diagrams:
 - 1) Provide block diagrams of all systems/sub-systems showing interconnects and relationships as a complete system.
 - 2) Describe all power requirements and connections. Indicate line and low voltage information, all UPS, battery back-up, and emergency/generator power.
 - f. Provide complete "point to point" wiring diagrams for all systems and subsystems. Indicate all components in the communications path from Central Control through all intervening system components, including terminal boards to the individual end devices. Document dedicated leased lines and associated equipment required to complete a transmission path. Where conductors are grouped into a cable for long site runs, a single line properly identified shall be indicated. Where these cables fan out for termination, individual wire terminations and markings shall be indicated.
 - g. Wire management details for the installation of cable harnesses inside racks, equipment cabinets, and consoles, control panels and other areas of exposed cable.
 - h. Shall be submitted at the same time as the Product Data Submittal.
3. Test Procedure:
- a. Provide written document detailing the test procedure for substantial completion of the system provided. These procedures shall include all tests recommended by the equipment manufacturer and by this specification.
 - b. Provide samples of system approval test sheets for review.
4. Screen Shots:
- a. VGUI Control Console "Screens": Submit for approval a detail drawing or screen snap shot of each control console "screen" depicting the exact layout to full size scale. Screens that distort the building floor plan layout are not acceptable. Representation of all colors shall be included, as well as the operator's orientation of the control panel in relationship to the control room and building.
 - b. Include a glossary of all icons available and a description of their function and actions shown beside an image of each of their varying states of status.
 - c. The review and approval of this submittal will only serve as a basis for proceeding forward with Phase I meeting of Software Support as described in paragraph 3.3.A. A second Screen Shot submittal shall be provided after the Phase I meeting to reflect any decisions made during that process.

1.6 TESTING

- A. The Security Control System shall be assembled and tested at the SCSC's shop. Refer to paragraph 3.3.B for Phase II expectations and requirements.
- B. Submit approved substantial completion test sheets seven (7) days prior to scheduled testing date.
- C. Conduct with Owner and/or Architect a comprehensive system test of all system components per the approved test plan. At completion of all testing, provide substantial completion test sheets.

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1.7 RECORD DRAWINGS

- A. The SCSC shall obtain, pay for, and keep up-to-date and available to the Owner or its representative, complete black-line prints as well as magnetic media copies of all computer drawings of the project, clearly annotated with "as-built" data as the work is performed. This data shall include the following:
 - 1. Routing of conduit and raceway.
 - 2. Routing of signal and power wire and cables, including the designations assigned to each wire/cable and field terminations schedules.
 - 3. Accurate location of all equipment installed under the specifications.
 - 4. A complete equipment list for each functional area.
- B. Upon completion and for inclusion into the Final Record Sets of drawings of this project, all as-built information shall be transferred to a full size set of AutoCAD drawings and transmitted to the A/E within 30 days of substantial completion.

1.8 GUARANTEE

- A. The SCSC shall guarantee all equipment & systems for a period of two (2) years commencing with Substantial Completion. The guarantee shall cover all costs for Warranty Services, including parts, labor, prompt field service, pick-up and transportation.
- B. The SCSC shall also provide an extended warranty for computer hardware that includes critical maintenance support services for a period of five (5) years commencing with Substantial Completion. Critical support services shall be available 24 hours per day, 365 days per year, with 4 hour onsite response time.
- C. The Owner shall be listed and registered as the owner of all SCSC provided equipment and software no later than the completion of the contractual warranty period.

1.9 WARRANTY AND PREVENTATIVE MAINTENANCE SERVICES

- A. The SCSC shall design the Security Control System to provide for remote PC connection with the new security control system. This remote connection shall be used by the SCSC during the warranty period for remote system troubleshooting and maintenance. The Owner/user will activate and de-activate the local communications device to ensure that unauthorized remote access to the security control system will not occur.
- B. Maintenance services within this scope of work shall include a preventative maintenance and system optimization inspection to be conducted every three (3) months during the first year of warranty. These visits shall be recorded at the site by signing in the Owner's daily operations log book and shall include, as a minimum, the following:
 - 1. Configuration Checks on video recorders
 - 2. Verify the integrity of all system software including Remote Viewing Stations.
 - 3. Configuration Checks on Access Control System Components and Software.
 - 4. Cleaning of air filters.
 - 5. Adjustment of video monitors picture controls.
 - 6. Tuning of video camera views (i.e., focus, iris).
 - 7. Configuration and through-put tests of system network (i.e., network switches)
 - 8. Inspection of cables and connections.

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9. Inspect and test all UPS units, including batteries and cables.
- C. Service response requirements shall include the following:
 1. Twenty-four (24) hour phone number to reach in-house troubleshooting personnel.
 2. Ability to restore functionality within eight (8) hours after notification on a twenty-four (24) hour basis.
 3. Service technicians trained by the manufacturers of the system components.
 4. Provide remote support within a four hour response time during regular business hours - 7am – 6pm, Monday – Friday, excluding holidays.

PART 2 - PRODUCTS

- 2.1 Refer to appropriate Division 28 section for specific product information.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Check location, “roughing in”, and field dimensions prior to beginning work.
- B. Do not begin installation until all unsatisfactory conditions have been corrected.
- C. Verify field measurements are as indicated on Drawings and as instructed by manufacturer.
- D. Verify that required utilities are available, in proper location, and ready for use.

3.2 INSTALLATION/APPLICATION OF ALL SECURITY PRODUCTS

- A. Field testing and inspection will be performed under the provisions of Section 285000.
- B. Replace equipment, components, & wiring as required to achieve a fully functional system.

3.3 SOFTWARE SUPPORT

A. PHASE I

1. Within three (3) months of receiving the approved shop drawing submittal, the SCSC shall request in writing a preliminary meeting with the Owner/Architect to discuss and demonstrate his working VGUI, programmed ‘In-House’ for the specific operations and functions of this project’s Security Control System. SCSC shall coordinate any proposed dates directly with the Architects Security System Specialist before any formal proposal or acceptance of dates by the GC. Also, the SCSC shall present an extensive outlined analysis of all his ‘In-House’ software’s performance possibilities and their potential applications and/or approval to be utilized on this project. Refer to paragraph 1.5.C.4 of this section for the ‘VGUI Screens’ shop drawing submittal requirements.
2. The SCSC shall prepare a detailed report summarizing all software design and function criteria to be submitted to the Owner/Architect for approval by appropriate parties no later than two weeks after the date of the Phase I meeting. The custom software that operates the security control system shall be designed specifically from this document.
3. The Phase I meeting shall outline the requirements of the custom software as it relates to integrating all the individual components and devices making up the Security Control System (VGUI, VMS, Intercommunications, Alarms, Locks, etc.)

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B. PHASE II

1. Prior to the scheduled date for job site delivery of the VGUI control stations, the SCSC shall request a second meeting with the Owner/User and Architect/Engineer at their manufacturing facility. SCSC shall coordinate any proposed dates directly with the Architects Security System Specialist before any formal proposal or acceptance of dates by the GC. The SCSC shall provide a full demonstration of the completed control consoles with a fully functional simulation of all the security control system software. The design and function of the 'In-House' software shall match the exact performance as specified in the detailed Phase I report. The SCSC shall include in their bid all expenses (travel, per diem, hotel and food) for four (4) owner representatives and two (2) architect representatives to attend the factory testing of the systems for a two (2) day period.
2. All deviations in the performance of the hardware or software shall be documented during this meeting, by the Architect/Engineer and SCSC, on a "pre-punch list". This "pre-punch list" shall be 100% corrected by the SCSC prior to delivering the equipment to the job site. Any additional comments shall now be incorporated.
3. During this time period, the SCSC shall perform all tests and critical conditioning on the security system to prepare the detailed diagnostic information and operational procedures for the service/operations manual.

C. PHASE III

1. Immediately following the installation of the security control system, the SCSC shall work with the Owner, the facility personnel, and the Architect/Engineer to correct any hardware problems or operational deviations from the original Phase I software design document. The SCSC shall modify the hardware/software as necessary to solve any problem resulting from poor installation.
2. Upon achieving a 100% functional security control system as determined by the Architect/Engineer, a documented release form provided by the SCSC shall be signed by the Owner and retained on file with the Project Manager. The SCSC shall continue to work on the installed hardware/software at no cost to the Owner or Architect/Engineer until the Owner's satisfaction is obtained by fulfilling the Phase I, II, and III document and a system release form is filed.

3.4 SPARES FOR ALL SECURITY CONTROL SYSTEM SECTIONS

- A. Each system provided by SCSC shall be built with the space, capacity, headend equipment and licenses to expand by 15 percent above those indicated for work of this project.
- B. Provide the following shelf spares:
 1. Provide one (1) PLC of each type used.
 2. Provide one (1) PLC input and one (1) PLC output module of each type used
 3. Provide one (1) PLC system power supply
 4. Provide one (1) Power supply of each type used
 5. Provide one (1) Duress station of each type used
 6. Provide one (1) Card reader and one (1) Keypad/Card Reader of each type used
 7. Provide one (1) Intercom station and one (1) Intercom master station
 8. Provide one (1) Speaker (ceiling mount) with baffle and one (1) wall mount Speaker

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9. Provide two (2) pre-programmed Fixed cameras and one (1) pre-programmed Multi-lens and PTZ camera with licenses of each type used.
10. Provide one (1) 24" VMS video monitor.
11. Provide one (1) 24" VGUI station with PC fully loaded with software for plug-and-play operation when an officer station VGUI/computer goes down.
12. Provide ten (10) relays, terminals, and fuses of each type used.
13. Provide one (1) spare of each type of surge protector.
14. Provide two (2) hard drives of type installed on this project for video archive storage.

END OF SECTION 285000

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SECTION 285010 – PLC, NETWORK, AND UPS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this section.

1.2 DESCRIPTION OF WORK

- A. The security control system shall be comprised of one or more programmable logic controllers and operator interfaces. The system shall include but not limited to, remote I/O, power supplies, input modules, output modules and any other required equipment to provide a fully functional system. The system will receive discrete inputs, and through the use of an internal control logic program, control output relay operations and perform remote control functions via the video graphic user interfaces.
- B. Provide labor, equipment, materials and supervision to install, program, calibrate, adjust, document, and test the total system as required herein, as shown on the drawings and required for the complete integration of the security system.

1.3 CONTROL, MONITORING, AND ANNUNCIATION

- A. The security control system shall control all electrically operated door hardware, monitor all doors position and bolt position limit switches, annunciate all door status and alarms. Lighting and receptacle control, intercommunication, paging, duress and video management control shall be integrated into the security control system. As part of video graphic user interface system, provide an integral security management system that shall record to disk, all occurrences of the system. Provide video graphic user interface terminals and security management system computers at locations as requested in the contract documents.
- B. The PLC System provides the logic control for the Security Control System. Unless noted otherwise, all user-initiated interfaces to the PLC system is performed through the Video Graphic User Interface (reference Section 285020). Critical control functions, such as door control and duress are to be executed by the PLC CPU program(s).

PART 2 - PRODUCTS

2.1 PROGRAMMABLE LOGIC CONTROLLER (PLC) SYSTEM

- A. General requirements
 - 1. Provide a Programmable Logic Controller (PLC) system that utilizes logic functions, memory, timing functions, software, I/O points, and communication capabilities for the control and/or monitoring functions of the systems described and shown in the contract documents.
 - 2. Each PLC shall be password protected against unauthorized entry to software.
 - 3. All components of the PLC system shall be by the same manufacturer, no mixing of multiple manufacturers shall be considered.
 - 4. Provide only UL Listed components.

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5. Provide a PLC System that seamlessly integrates the control system to the Local Area Network Hubs.
6. Provide CPU(s) with a visual status indication of backup battery.
7. Provide alarm in the event of CPU low battery voltage before battery failure.
8. Provide 15% spare PLC system capacity at the completion of the project. This includes program memory, I/O memory allocation, register memory, user memory, etc.
9. Provide programming that utilizes a simplistic logic format that can easily be modified by 3rd party vendors.
10. Provide 15% spare PLC I/O module capacity at the completion of the project. Calculate inputs and outputs separately when figuring capacities.
11. All PLC interposing relays must be fused to protect the relay and field device wiring from over-current caused by shorts or device failure.
 - a. Exception: Whereas the terminal block is in receipt of a dry contact from another system, a fuse isn't required on that portion of wiring.
12. PLC Central Processor Unit
 - a. Provide expansion chassis and power supply module with each processor assembly as needed.
13. PLC Digital Inputs and Outputs
 - a. Each input or output module shall be a self-contained unit.
 - b. It shall be possible to replace any I/O module without disturbing or removing user field wiring.
14. PLC Remote Inputs and Outputs
 - a. The remote I/O system shall be compatible with all of the modular I/O systems.
 - b. Power will be provided by the I/O rack assembly power supply.
15. Termination Labeling
 - a. Each wire will be labeled with an industry standard thermal transfer wire marker.
 - b. I/O wire number should reference wiring diagram and Software I/O list.
 - c. Felt tip pen labels are unacceptable.
16. The control architecture will use distributed control over the Ethernet network.
17. Local and remote networking shall be via dedicated interface modules providing serial communications at rates, which are selectable from 62.5K to 1M, bits per second. The interface modules shall be capable of I/O drops at distances of up to 7,500 feet and control up to 32 remotes.
18. The PLC shall have a communications card capable of communicating with an industry standard stand-alone computer.
19. Communication between the PLC and the computer(s) shall be a peer to peer network; no master station (central hub or server) shall be required.
20. Communication on the peer to peer network shall be a minimum of 50 K baud of data transmission.
21. There shall be no noticeable delay between any video graphic user interface icon or field device input and the resulting output on the video graphic user interface or in the field.
22. Door Monitoring and Control: The lock position switch (LPS) and door position switch (DPS) shall be wired in series so that the circuit is closed when the door is closed and secure. If either the LPS or DPS circuits open the VGUI shall report the door as being open/unsecure. If the door is a sliding door or overhead door, then the open and close

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limit switch will be wired as separate inputs to the PLC and will not be part of the sliding or overhead door control circuits.

- a. Unless otherwise stated, all electrically controlled and/or monitored doors shall be connected and controlled and monitored by the PLC System.
- b. All electric locks shall be individually fused. Provide door control relays with indication light.
- c. Locks shall be controlled via mechanical interposing relays driven by the PLC. Solid-state relays are not acceptable. Provide all required power to control doors.
- d. Interlocks shall be implemented via PLC software. Any door shall have the ability to be programmed to become a member of an interlock scheme. The Architect and/or owner shall reserve the right to re-define interlocks during the submittal phase without additional costs to the owner.
- e. Upon a loss of power, faults or communication failures with PLC input and output modules or PLC CPUs, all electric locks shall de-energize (fail-secure). Sliding and overhead doors shall remain in their present state.

B. PLC Specifications:

1. PLC Central Processor Units
 - a. Processor to serve up to 2048 I/O points or more
 - b. Minimum 64K word instruction memory
 - c. RS-232 ASCII configurable auxiliary com port
 - d. Bit instruction execution time of 0.80 μ s max
 - e. Built in real time clock and calendar
 - f. Built in 100Mb or Gigabit Ethernet port
 - g. Battery backed EEPROM memory
 - h. Connectivity via Ethernet, Devicenet, Modbus RTU master/slave over RS-485 and RS-232-C.
 - i. Shock rating, operating – 30.0g (3 pulses, 11 ms)
 - j. Vibration rating – 1.0g @ 5-2000 Hz
 - k. Operating Temperature range – 32 to 140 Degrees F
 - l. Operating Humidity range 5 – 95% RH non-condensing
2. PLC Digital DC Input Modules
 - a. 10 – 30 VDC operating range
 - b. Sourcing or Sinking type modules
 - c. Maximum on/off signal 0.5mS max with selectable 1 or 7mS filter
 - d. Maximum off state current 0.5mA
 - e. 32 point modules minimum
 - f. Maximum backplane current load – 50mA
3. PLC Digital DC Output Modules
 - a. 10.2 - 30 VDC operating range
 - b. Sourcing or Sinking type modules
 - c. Maximum continuous current per output, .5 amp sourcing/1.0 amp sinking
 - d. Maximum continuous current per module, 8 amp sinking or sourcing @ 60° C
 - e. 32 point modules minimum
 - f. Maximum backplane current load – 90mA @ 5 VDC
 - g. Removable terminal blocks
 - h. Gold plated contacts
4. PLC Power Supplies
 - a. 120/220 VAC nominal input voltage

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- b. Maximum input power, 27 VA
- c. Backplane output current, 1.5 amps total
- d. Operating Temperature range – 0 to 60° C
- e. Operating Humidity range 5 – 95% RH non-condensing
- 5. Acceptable Manufacturer
 - a. Omron

2.2 LINEAR POWER SUPPLY

- A. Provide linear power supplies as required for control power.
 - 1. Specification
 - a. AC Input: 120 VAC, +10%, -13%
 - b. DC Output: 24 VDC (5A or 10A as required)
 - c. Line Regulation: +/- .05% for a 10% change
 - d. Load Regulation: +/- .05% for a 50% load change
 - e. Output Ripple: 3 mV peak-to-peak maximum.
 - f. Transient Response: 50 microseconds for 50% load change.
 - g. Short Circuit Protection: Automatic current limit/fold back
 - 2. Provide back plates, mounting hardware and all appurtenances required to install the power supplies in the system equipment racks.
 - 3. An individual homerun cable is required to each field device from the power supply. Do not loop-wire or daisy-chain power, or tap power conductors from a junction box. Device power will be part of the control wiring to the device
 - a. Exception: 120 volt continuous power wiring, such as exterior camera power
 - 4. The output of the power supply is to feed a series of fuses rated for the intended load. One each per homerun cable/device load
 - 5. Acceptable Manufacturer
 - a. Phoenix Quint-series
 - b. Sola
 - c. Power One
 - d. Or Approved Equal

2.3 RELAYS AND TERMINALS

- A. Relays - General
 - 1. The relays shall provide actual switching of power to electric locking hardware, lights, etc.
 - 2. All relays shall be of electro-mechanical type and be standard off-the-shelf commercially available components.
 - 3. Relays and terminals for each device shall be grouped together, and each terminal shall be labeled.
 - 4. Relays shall be pluggable with diode protection across coils and LED indication of activated coil circuit.
 - 5. Each relay contact to the control device shall be individually fused.
 - 6. Low voltage wiring in relay cabinet shall be separated from high voltage wiring and all wiring shall be color-coded and marked with approved wire markers.
 - 7. Control wiring shall be routed through plastic wire duct and landed on terminal strips.
 - 8. Relays shall be controlled directly by the PLC.

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9. Peripheral interface cards with active circuitry will not be approved.
 10. SPST or DPDT as required. The relays will perform the actual switching of the power to the locks. Electric locks shall not be controlled directly by the PLC.
 11. Acceptable Manufacturers:
 - a. Idec
 - b. Potter and Brumfield
 - c. Phoenix Contact
 - d. MTI
 - e. Or Approved Equal
- B. General Purpose Relays
1. Specifications
 - a. Switching Capacity: 6 Amp continuous, 8 Amp inrush.
 - b. Duty cycle: 100%
 - c. Termination: Screw Connection
 - d. Operating Indicator Light, Damping diode, polarity protection diode
 - e. Operating Voltage: 24 VDC
 - f. Temperature: -20 C to 55 C
 - g. DIN Rail Mountable Socket
- C. Special Purpose Relays (High Power)
1. Specifications:
 - a. Relays contacts shall be U.L. listed for a continuous current of 10 amps (inrush of 16 amps)
 - b. Termination: Screw compression
 - c. Operating Indicator Light
 - d. Coil Rated Current: < 70 ma
 - e. Operating Voltage 24 VDC
 - f. Max. Cont. Applied Volt: 110%
 - g. Drop-out Voltage: 10%
 - h. DIN Rail Mountable Socket
- D. Fuses Terminal Blocks
1. Specifications
 - a. Din Rail mountable IEC style (if external from Relay boards)
 - b. Should be dead front safety (ie. touch safe)
 - c. Screw clamp and Spring Clamp are acceptable
 - d. All Fuse terminal blocks will be sized accordingly to the wire gauge and current load required for the application.
 - e. Provide lever disconnect type IEC fuse blocks.
 2. Acceptable Manufacturer
 - a. Allen Bradley
 - b. Phoenix Contact
 - c. Square D
 - d. Or Approved Equal
- E. Modular Terminal Blocks
1. Specifications
 - a. Din Rail mountable IEC style (where external terminal blocks are needed)
 - b. Dead front safety (ie. touch safe)

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- c. Screw clamp and Spring Clamp type acceptable
 - d. All terminal blocks will be sized accordingly to the wire gauge and currents load required for the application.
 - e. Safety grounds should be identified with yellow/green color.
 - f. One wire per termination point unless Ferrules are used for special applications
 - g. All ferrules are to be crimped using the manufacturer's recommended crimping tool.
 - 2. Acceptable Manufacturer
 - a. Allen Bradley
 - b. Phoenix Contact
 - c. Square D
 - d. Or Approved Equal
- F. I/O Boards
- 1. Input boards shall be optically isolated and designed to accept an input signal of 24 volts AC or DC. These boards shall be capable of rack mounted. Each input point shall have a corresponding LED indicator which illuminates when the input is read as on by the microprocessor. These boards shall be configured in a minimum of 16 inputs.
 - 2. Output boards shall be reed relay outputs with ability of isolated commons. These devices shall be capable of rack mounted. Each output shall be fused and be accompanied by a LED indicator which illuminates when the processor issues a command to energize the output, and a second LED to indicate the condition of the fuse. These boards shall be configured in a minimum of 16 outputs.
 - 3. Boards combining inputs and outputs on the same board will be acceptable provided they meet the requirements listed above.

2.4 SECURITY LOCAL AREA NETWORK

- A. Provide an independent secure Local Area Network (LAN) that shall include connections between the PLC system, graphic user interfaces, intercommunications/audio system, video management system, card access, and other integration system CPUs.
- B. The LAN shall be a high speed, fault tolerant, self healing Ethernet industrial communication network. It shall be a tree topology using fiber optic media as required and be in compliance with IEEE 802.3.
- C. The Ethernet Network shall consist of CAT6 UTP cable within the structure for distances less than 100m.
- D. Ethernet UTP shall be run without splice unless terminated through the appropriate patch using RJ-45 connectors or approved punch down blocks.
- E. Fiber Optic shall be used:
 - 1. For the network backbone
 - 2. Between structures
 - 3. Any application beyond the building walls (exterior)
 - 4. Distances over 100m
- F. Network Fiber Optic transceivers shall be integral to the network scheme, utilizing SFP or mini-GBIC technology for the network backbone between switches. Separate converters will not be allowed for Ethernet backbone.

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1. Fiber Optic connectors shall conform to the device served without the use of adapters.
2. Terminate all unused fibers in a patch panel using correct and consistent labeling at both ends.

2.5 NETWORK SWITCHES

- A. Provide switches for the IEEE802.3a-f 10/100/1000 BASE-T Local Area Network connectivity and 1 Gigabit minimum uplink capability. Provide stackable switches for faster uplink speeds.
 1. 24 RJ-45 ports minimum (Switches shall be sized as required)
 2. Auto crossing, auto negotiation
 3. LEDS: Link Integrity and Status, Link speed, RPS, PoE
 4. PoE (power over Ethernet) capable, with up to 30W per port
 5. 370W or 740W fixed power supply option
 6. Operating Temp -5°C – 45°C
 7. 100 – 240 VAC, 50 to 60Hz, 5A max
 8. 19" Rack Mountable
- B. Acceptable Manufacturers
 1. Cisco
 2. HP
 3. Approved Equal

2.6 UNINTERRUPTIBLE POWER SUPPLIES (UPS)

- A. This section defines the electrical and mechanical characteristics and requirements for a continuous-duty single-phase, solid-state, uninterruptible power system. The UPS will provide high-quality AC power for sensitive electronic equipment loads.
- B. Ratings
 1. 120 Volt Nominal Units, Single Phase
 2. UL Standard 1778
 3. NEMA Type 1 Enclosure
 4. FCC Part 15, Class A
- C. The SCSC shall supply UPS power at each Security Electronics room, sized to provide adequate and protected power for the loads served.
- D. Submit a list of loads showing the ratings (amps, watts, volts) and the time-wattage charts for the UPS. The list shall include a side bar showing the BTU-hr heating effects of the equipment in the control rooms and equipment room. Include the BTU-hr heating effects of the selected UPS.
- E. Provide the size and quantity of UPS units required to support the attached load to be served plus an additional 20% headroom.
- F. Provide a UPS at each rack, cabinet and VGUI. The UPS shall have sufficient battery capacity and charging capacity to operate all security system equipment (to include VGUI(s), SMS, PLC system, all door monitoring, audio system, camera system and digital video recording system) for a period of 5 minutes at full load without degradation to the system. Only rack mounted UPS systems may be used in equipment rack or console locations.

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- G. Devices with built in battery backup such as door lock power supplies or card access panels do not require a separate UPS. UPS or battery power is not required for door lock power supplies.
- H. The UPS system shall interface with the PLC System providing indication of "UPS trouble" status of the unit(s). Provide interface to Central Control to monitor both alarm and trouble signals from each UPS.
- I. Where the total number of circuits required for UPS-fed apparatus from any individual UPS unit that feeds a main or remote rack exceeds six circuits, the SCSC shall furnish and install a minimum of a 100 ampere main-breaker panelboard.
 - 1. The panelboard shall be rated for the required load, but at a minimum it shall be 100A bus with 60A Main Breaker, 120/240V, 10K AIC, single phase, three wire, with ground bus, and furnished with a minimum of (8) one-pole 15 or 20 amp bolt-in circuit breakers installed.
- J. All UPS branch circuitry, inclusive of the main distribution panelboard, must be installed by a licensed electrical contractor with journeyman electricians in attendance. If requested, the SCSC must provide proof of expertise.
- K. The UPS is designed to operate as a true on-line double conversion system in the following modes:
 - 1. Normal - During normal operation, utility power provides energy to the UPS. The filters, the power factor correction circuit and the inverter process this power to provide computer-grade power to connected loads. The UPS maintains the batteries in a fully charged state.
 - 2. Battery - The UPS will enter Battery mode if there is an extreme power surge, extreme power drop, or utility failure. The battery system supplies power through the DC-to-DC converter to the inverter to generate computer-grade power for the connected load.
 - 3. Recharge - Once utility power is restored, the UPS resumes normal operation and the Battery Charger begins recharging the battery.
 - 4. Bypass - Bypass mode provides an alternate path for utility power to the connected load in the unlikely event of a UPS malfunction, such as overload, overtemperature, or an internal circuit failure.
 - 5. Automatic Restart - Upon restoration of utility / mains AC power, after a utility mains AC power outage and complete battery discharge, the UPS automatically restarts and resumes supplying power to the critical load and the battery charger automatically recharges the battery.
- L. Design Requirements
 - 1. Voltage: Will operate at either 120/208V or 120/240V by sensing the utility phase angle and configuring the dual inverters to the same angle: 120 or 240 degrees, (or) 180 degrees. Coordinate power requirements with EC during submittal phase.
 - 2. Nominal input/output voltage specifications of the UPS at rated load are:
 - a. The UPS will operate on voltage ranging from 120/208V, 60/50 Hz, (or) 120/240V, 60/50 Hz without the use of selector switches or voltage taps. Input wiring must be 3-wire (L1, L2, N) -plus-ground. The output voltage is automatically set to match input voltage.
 - 3. Output Load Capacity: Specified output load capacity of the UPS is:
 - a. 6000 VA/4200Watts at 0.70 power factor for 120/208V and 127/220V with all L-N loads

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- b. 5200 VA/4200 Watts at 0.81 power factor for 120/208V and 127/220V with all L-L loads.
 - 4. Internal Battery: Valve regulated, non-spillable, lead acid cells.
 - 5. Reserve Time: 4200W minimum 5 minutes with ambient temperature of 77°F (25°C).
 - 6. Battery Recharge: The UPS contains a battery recharge rate designed to prolong battery life. Recharge time for UPS internal batteries is six (6) hours maximum to 90% capacity after a complete discharge into full load.
 - 7. Input Line Transient Immunity: The UPS withstands input line transients in compliance with IEEE c62.41, Category A and
 - 8. Surge Protection: The UPS utilizes MOV ratings will be 175 Volt, 150 Joules minimum connected L1-N and L2-N; 300 Volt, 150 Joules minimum connected L1-G, L2-G and N-G
 - 9. Battery Mode Neutral Grounding: UL1778 requires each input pole to be disconnected from the source during battery operation. The patented design of the UPS includes a relay to bond the output Neutral to Ground during battery mode operation to prevent a floating output neutral during battery mode operation.
- M. Environmental Conditions
- 1. Ambient Temperature: + 32°F to + 104°F (0°C to +40°C) for altitudes 0 to 5,000 feet (0 to 1500 meters) above sea level. + 77°F (25°C) for optimum battery performance.
 - 2. Relative Humidity: 0 to 95% non-condensing.
 - 3. Storage: 0 to 95% non-condensing.
 - 4. Audible Noise: Noise generated by the UPS under normal operation does not exceed 55dBA when measured at 1 meter from the surface of the UPS.
 - 5. Electrostatic Discharge: The UPS is able to withstand an electrostatic discharge compliant to EN61000-4-2, level 4, Criteria A, without damage and will not affect the connected load.
- N. The UPS unit is comprised of the input PFC converter, battery charger, dual-inverter, input filter, automatic bypass circuit, housed in a rack - tower NEMA type 1 enclosure
- O. The UPS shall meet the requirements of IP20.
- P. The UPS is forced air cooled by internally mounted continuous fans. Fan power is provided from the internal DC supply. Air intake is through the front of the unit and exhausted out the rear of the unit.
- Q. Converter: Incoming AC power is converted to a regulated DC output by the input converter for supplying DC power to the inverter. The input converter provides input power factor correction (PFC) and input current distortion reduction.
- R. AC Input Current Limit: The input will use whatever power is needed to power the output overload specification before going to batteries. The UPS does not use electronic input current limiting. The UPS includes a 2-pole switch-type 30A input breaker.
- S. Input Protection: The UPS has built-in protection against undervoltage, overcurrent, and over-voltage conditions including low-energy lightning surges, introduced on the primary AC source. The 208 VAC models can sustain input surges without damage per criteria listed in ANSI C62.41 Cat. A & B.

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- T. Battery Recharge: The UPS contains a battery recharge rate designed to prolong battery life. The battery is constant current charged to restore capacity, then shall be constant voltage charged to maintain the battery in a fully charged state. Recharge time for the internal battery shall be six (6) hours maximum to 90% capacity (full load discharge rate). There is DC over-voltage protection so that if the DC voltage exceeds the pre-set limit, the inverter will shut-down automatically and the critical load will be transferred to bypass.
- U. Other General Features:
1. The UPS inverters are a pulse-width-modulated (PWM), IGBT design capable of providing the specified AC output. The inverters convert DC power from the input rectifier output, or the battery, into precise sinewave AC power for supporting the critical AC load.
 2. Overload: The inverter is capable of supplying current and voltage for overloads exceeding 100% and up to 201% of full load current. A visual indicator and audible alarm indicates overload operation. For greater currents or longer time duration, the inverter has electronic current-limiting protection to prevent damage to components. The inverter is self-protecting against any magnitude of connected output overload. Inverter control logic senses and disconnects the inverter from the critical AC load without the requirement to clear protective devices.
 3. Inverter DC Protection: The inverter is protected by the following DC shutdown levels:
 - a. DC Overvoltage Shutdown
 - b. DC Undervoltage Shutdown (End of Discharge)
 4. Output Frequency: An oscillator controls the output frequency of the UPS. The inverter maintains the output frequency to + 0.1 Hz of nominal frequency during battery mode, frequency converter mode, or when otherwise not synchronized to the utility/mains source.
 5. Output Protection: The UPS inverter employs electronic current limiting circuitry for protection during normal mode and battery operation, and input circuit breaker protection during bypass mode operation.
- V. Display and Controls
1. General: The UPS is provided with a microprocessor-based control and a status display section designed for convenient and reliable user operation. The monitoring functions such as status and alarm indicators are displayed on a front-panel LED display.
 2. System Indicators: The UPS includes five individual LED status indicators, and three rows of LED's to indicate UPS load and battery capacity. An audible alarm will be used in conjunction with the visual indicators to indicate to the operator a change in UPS operating status.
 3. All audible alarms can be silenced, with the exception of low battery, bypass reminder, and missing batteries at startup alarms. Once silenced, the audible alarm will not sound until a new alarm condition is present. Standard LED indicators are described below:
 - a. Load Level indicators – 10 total: 4 green and 1 amber, for each of the L1 and L2 outputs. The Load Level indicators display the approximate load level at all times.
 - b. Battery Capacity indicators - 5 green LEDs. The Battery Capacity LEDs display the approximate level of battery reserves.
 - c. Fault indicator - 1 red LED. The Fault indicator LED illuminates if the UPS detects an internal problem. One or more of the Battery Capacity indicators may be illuminated to aid in diagnostics.

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- d. AC Input indicator - 1 green LED. The AC Input indicator LED is illuminated when utility power is available and falls within the input specification.
 - e. UPS ON indicator - 1 green LED. The On Inverter indicator LED is illuminated when the UPS inverter is operating and supplying power to connected loads.
 - f. On Bypass indicator - 1 amber LED. The On Bypass indicator LED is illuminated when the bypass source is supplying power to connected loads.
 - g. On Battery indicator - 1 amber LED. The On Battery indicator LED is illuminated when the AC Input is out of the acceptable operating range.
- 4. On-Standby-Off Controls: UPS start-up and shutdown operations are accomplished by the "ON" and "STANDBY" push buttons located on the front panel of the UPS. The "ON" push button is a means to turn the UPS on and also serve as a means to manually test the battery. The "STANDBY" push button allows manual transfers of the load from the inverter to bypass power. Pressing the "STANDBY" push button, in bypass mode or battery mode, will completely shut down the UPS and its connected load.
 - 5. On-Line Battery Test: The UPS features an automatic battery test with the factory default test interval set at every 2 weeks. The battery test will ensure the capability of the battery to supply power to the inverter while loaded. If the battery fails the test, the UPS will display a warning alarm to indicate the internal batteries need replaced and resume operation without disturbing the load. The battery test feature is user accessible by the push button located on the front of the unit.

W. Bypass

- 1. General: A bypass circuit is provided as an integral part of the UPS. The bypass shall have a make-before-break transfer, will have a maximum detect and transfer time of 4-6 milliseconds, and be a double-pole device. The bypass circuit is designed to ensure the simultaneous transfer of the L1 and L2 poles.
- 2. The bypass is configured to wrap around the PFC converter, battery charger, DC-DC converter, inverter, and battery. The bypass circuit will use the rear-panel mounted UPS input circuit breaker and route bypass power through the UPS input filters and surge suppression circuit. The bypass circuit default position is in the bypass mode (utility).
- 3. Automatic Transfers: The transfer control logic automatically activates the bypass, transferring the critical AC load to the bypass source, after the transfer logic senses one of the following conditions:
 - a. UPS overload
 - b. UPS over temperature
 - c. PFC failure
 - d. Inverter failure
 - e. DC Bus Overvoltage
- 4. Once overload condition is reduced, the load is automatically transferred back to inverter power. An over temperature requires manual transfer back to inverter power after cooling.

X. Maintenance Bypass Switch

- 1. The unit shall be installed on all UPS units over 4KVA.
- 2. Similar units will be required for rack-mounted UPS units of 1.5KVA and 3KVA
- 3. The unit allows the ability to take the UPS off-line (transferring to normal power) so the UPS can be serviced.
- 4. Unit shall be UL1008 listed

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5. Manually initiated electrical operation
6. The unit shall have high interrupting ratings, current ratings at 100%, and a solid neutral
7. Pilot lights will indicate NORMAL or BYPASS
8. This external maintenance bypass switch is a MBB (Make Before Break) switch with a locking handle. It must be mounted on the wall near the UPS.

Y. Internal Battery

1. Valve regulated, non-spillable, lead acid cells are used as a stored-energy source for the specified UPS system. The battery kit is internal to the UPS cabinet, and sized to support the inverter at rated load and power factor, with ambient temperature of 77°F (25°C) for a minimum of 5 minutes reserve time. The expected life of the battery shall be 3 - 5 years or a minimum 250 complete discharge cycles at ambient temperature of 77°F (25°C). To promote battery service life and eliminate over-discharge of the battery, the end-of-discharge DC shutdown voltage will be automatically adjusted by the microprocessor based upon the percentage load at the onset of battery operation.

Z. Output Distribution

1. Output distribution is integral to the UPS cabinet, and located on the rear of the unit. The output distribution shall provide the capability to re-configure the UPS input and output connections via a removable sheetmetal power distribution box. Distribution options shall be available with break-before-make maintenance bypass switch to allow for complete shutdown and isolation of the UPS for service without powering down the connected loads. Maximum transfer time of the maintenance bypass switch shall be 4-6ms

AA. Communication Options

1. UPS shall have a DB-9 Serial Port (9 pin female) connector on the rear panel to provide UPS status communications. The UPS will communicate via serial communications using Liebert ESP II protocol. The DB9F will also include photo-couplers to signal "on battery" and "low battery" operational status. The UPS will be capable of receiving a signal from the connected host system to initiate a UPS shutdown, when operating from battery power. This signal will be a +5V to +12V level that must remain for at least a 1.6 second duration.

BB. Acceptable Manufacturers

1. Liebert
2. Eaton
3. APC
4. Cyber Power
5. Or Approved Equal

2.7 SURGE/LIGHTNING PROTECTION

A. General

1. All data, power, audio and video signal cables entering the facility from a point exterior to the building shall be equipped with a silicon avalanche diode type of lightning protection.
2. Surge Protection Devices (SPDs) shall be supplied by an ISO 9001:2000 certified company in the business of manufacturing.

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3. Product data submittals shall include 8/20 μ s rated surge capacities, relevant IEEE and IEC specifications, installation instructions, and operating characteristics.
 4. Mounting guidelines will be followed as indicated in installation instruction provided by manufacturer.
 5. Protector shall be located at the first cabinet through which the cable or conductor passes upon entering the building.
 6. The SPD shall be mounted as close as possible to the equipment or service being protected.
 7. All wiring points and plug connections shall be "touch safe" with no live voltages that can make contact with a misplaced finger in accordance with IEC 529.
 8. The SPDs shall have integral mounting brackets to attach to 35mm DIN rail conforming to DIN EN50022. The mounting bracket of the SPD shall make ground connection to the DIN rail; therefore, minimizing ground impedance connections. The DIN rail and enclosure will be electrically grounded. For installations requiring a high number of SPDs in a single cabinet, a 19" rack mount SPD with provisions for 4 to 24 channels of protection will be acceptable.
- B. Surge Protection Devices For 120v AC Power Circuits
1. 120VAC surge protection devices shall be installed on each non-UPS or emergency circuit feeding security devices.
 2. The SPD shall be UL listed or recognized to UL 1449, 2nd edition.
 3. SPDs for single phase equipment shall be designed to withstand up to a 10kA test current of a 8/20 μ S waveform according to IEC 1024 Application Guide A and IEEE C62.41.1-2002 Category C area.
- C. Surge Protection Devices For Ethernet Data Networks
1. SPDs shall be designed for protection of transmission of Fast Ethernet (100Mbps) over Category 5e cable as a minimum.
 2. The protection circuit shall have fine protection diodes between all the signal wires, as well as coarse protection between shield and ground.
- D. Acceptable Manufacturers
1. Phoenix Contacts
 2. Approved equal

END OF SECTION 285010

SECTION 285020 – VIDEO GRAPHICAL USER INTERFACE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this section.

1.2 WORK IN THIS SECTION:

- A. This section contains the requirements and operational characteristics for a security control system. The system shall feature video graphical user interface(s) (VGUI) as shown on the plans allowing control for the automated security control system. The Control functions to be initiated by the VGUI include, but are not limited to the following:
 - 1. Door control and monitoring.
 - 2. Interface between intercom stations and speaker output selections.
 - 3. Interface between video surveillance system alarm inputs and monitors.
 - 4. Interface between the control of power circuits for lighting, outlets, and solenoid valves for plumbing.
 - 5. Interface, control and monitoring of card readers, push buttons, and duress stations.
- B. System shall also include a Security Management System (SMS) which shall operate as separate terminals as shown on the plans. The system shall provide administrative viewing and retrieval of database information. Data stored within the database shall be stored in Windows-compatible files for exportation and report generation.

1.3 OPERATIONAL DESCRIPTION

- A. General Description - The VGUI display shall be divided into three main sections; the Map Display, the Site Map and the Function Control Bar (FCB) on the 24" touch screen(s).
- B. The Map Display is the main section on the left of the monitor screen displaying a 2-dimensional view of a selected area in the facility. Each view is referred to as a "Map". The Maps shall have graphic icons representing all monitored and controlled devices placed on the floor plan in their approximate location. The graphics shall optimize the use of screen resolution and color to enhance and simplify the information displayed. Each operator station located in open dayrooms shall have an "Emergency Disable" Icon, red in color that shall allow the operator of that station to shut down the operator station if under duress located in the top left hand corner of the Map Display area. By disabling the operator station, Central Control has taken over the capabilities of this station. Central Control will be required to re-enable the station once the duress situation has been resolved.
- C. PTZ controls shall be provided on the Screen when PTZ cameras are used.
- D. The Site Map is the section of the screen that is used to navigate between maps and view the other areas of the facility. The operator shall select an area in the Site Map by clicking on the area with the mouse/touch point. The area will be highlighted in white

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in the Site Map and be displayed in the Map Display area. The time duration to generate any screen within the VGUI shall not exceed one ½ second. The Site Map area shall have an Intercom Call Pending List Display that shall display all current incoming intercom calls. In order to perform a function, the operator must select an intercom call. Once the intercom is selected the station shall be connected to the intercom master station as well as display the area on the Map Display where the call was originated. The Site Map area shall also have an Active Call Station Display that will be activated when an operator selects an intercom call.

- E. The FCB section of the monitor screen is used to control devices in the facility. Door control functions shall require a two-step operation. The two-step operation is to protect the operator from accidentally opening a door. The operator will select a function Icon in the FCB and then select a Door Icon for a normal door unlock.
- F. The FCB shall have a "Utility" Icon. The Utility control is a hidden function on the VGUI screen, therefore, the operator will not see any utility Icons on the Map Display until the Utility Icon in the FCB is selected. Once the Utility Icon is selected the utilities alone will display graphically on the Map display for three seconds. If a Utility Icon on the Map display is not selected within three seconds the command cancels, and the previous Map will be displayed. Activating a utility shall be done by selecting the appropriate Icon on the Display map. When a utility has been selected or turned on, the Icon symbol will change to a yellow color and will stay yellow until it is selected again/turned off.
- G. Included in the Central Control operator control panel is a PLC Status Icon that will allow the operator to check the state of all the PLC modules in the facility. The PLC modules shall be grouped by PLC equipment cabinet or rack in black print and will be highlighted in red print if offline.
- H. In the event a PLC or PLC module does go offline, a pop up will appear on the screen which will allow the operator to go directly to the PLC status screen.
- I. Central Control shall have the ability to view all screens of the facility with status of all doors, and alarm conditions regardless of which VGUI has primary control of those devices. No device or door shall be controlled by two operator stations simultaneously.
- J. Icons for doors, intercoms, cameras, etc, which are under primary control of Central Control (i.e. movement doors, exterior doors for sally ports, etc.) shall be displayed as standard icons as described in the sections to follow and can be controlled by Central Control.
- K. Icons, which are under primary control of the local VGUI, shall appear on these same Central Control screens as 'sunken' into the screen with a passive or reverse video color. The status of the door position switch (DPS) and lock position switch (LPS) shall be dynamically displayed as described in the sections to follow for both primary and secondary door icons. The intent is to allow Central Control to be aware of door movement in pods, booking areas, etc, while leaving control of those doors with the local VGUI.
- L. Local VGUIs shall display icons of doors, intercoms, cameras, etc, which are under primary control of Central and shall appear on these same local VGUI screens as 'sunken' with a passive or reverse video color. The intent is to allow the local VGUI to be aware of door movement in & out of Pod movement doors, booking area's

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movement doors & exterior sallyports and the vehicular sallyport, etc, while leaving control of those doors to Central Control.

1.4 VIDEO GRAPHIC USER INTERFACE EVENT SUMMARY

- A. An event-based strategy shall be applied to the development of the VGUI screens. Color utilized in the screen development shall be neutral gray in nature. Events shall be exceptions to the screen and shall be highlighted both visually using color. Owner shall be able to change color designations at no additional cost.
- B. The system shall also incorporate the use of voice announcements and beeps and chimes so that all operator actions, system warnings and emergencies and other important information are announced to the operator. Alarm announcements shall be displayed until they are acknowledged, regardless of screen display. The operator will not have to wait for the sound to be completed before proceeding to other screen functions unless it is an emergency function.

1.5 ALARM PRIORITIES

- A. As part of the VGUI, provide priority alarms and calls associated with different events and icons. Prioritization of alarms shall be limited to a total of seven levels. The Owner reserves the right to provide two additional priority levels or change the priority levels listed below during the Phase I software writing process.
 - 1. Level #1: Duress Alarms
 - 2. Level #2: Breach of interlocked Sally Port
 - 3. Level #3: Door Alarms
 - 4. Level #4: Intercom calls
 - 5. Level #5: Inmate cell intercom calls

1.6 LOG IN

- A. Each graphical user interface station has a log in screen when the station is enabled from Central Control. The user must input a valid username and password combination to gain access into the system. Each user will have a particular level of access – administrator, supervisor, user.
- B. To change the door shunt feature, hold open alarm, intercom isolate feature, and the auto log off timer, the individual logged on must have supervisor level privileges.
- C. Each operator station that is not located in a secure control room will have an auto-log off feature. If the operator has not performed a function in a configurable amount of time, the system logs off and rolls to Central Control.

1.7 DEVICE ICONS

- A. The VGUI shall have Device Icons located in the Map Display including, but not limited to Door Icon, Intercom Icon, Camera Icon, Page Zone Icon, Duress Icon, Card Reader Icon and Group Control Icon. All maps shall be sized to allow for icons that measure 3/8" x 3/8" or larger when measured on actual monitor. Provide at least 1/8" separation between icons. The VGUI shall also have Function Icons located in the FCB including Unlock Icon, Stop Icon, Hold Open Icon, Door Isolate Icon, Intercom Isolate Icon, Interlock Override Icon, All Page Icon, Silence, and Reset Icon.

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1.8 DOOR CONTROL

- A. The steps required to open a swinging, sliding or overhead door are the same. The operator will first select the Unlock Icon in the FCB and then within three seconds, select the Door Icon in the Map Display. Other doors may be commanded to unlock by selecting other Door Icons within the three seconds of the first.
- B. To stop motion of a sliding or overhead door the operator will select the Stop Icon in the FCB.
- C. Door Status Alarm Indication:
 - 1. Unauthorized Access / Breach:
 - a. All controlled doors shall provide an unauthorized or breach alarm to the VGUI anytime a door opens by any means (such as forced or keys) that is not authorized by the security electronics control system (VGUI, PLC, card access).
 - b. Monitored only doors do not provide unauthorized access or breach alarms unless otherwise noted in the drawings.
 - c. Unauthorized access or breach alarm door breaches shall be programmed as a standard default feature and not provided as an option.
 - 2. Door Held Open / Door Prop:
 - a. All controlled and monitored doors shall provide an alarm to the VGUI anytime a door is held open beyond a configurable amount of time, unless otherwise noted in the drawings.
 - b. The alarm can be silenced, reset and removed from the queue even if the door has not been re-secured. Every day that the hold open alarm is not resolved (a secure indication for that door has not been received into the system), a new hold open alarm for that door shall come into the VGUI.
 - c. Door held or prop alarms shall be programmed as a standard default feature and not provided as an option.
- D. The Door Icons in the Map Display shall have a graphical representation of the door. The LPS and DPS shall be wired in series so that the circuit is closed when the door is closed and secure. If either the LPS or DPS circuits open the VGUI shall report the door as being open/unsecure. If it is a swinging door it depicts the door swing and if it is a sliding or overhead door it shall depict the door as secure, in mid travel or fully open.
 - 1. The Door Icon is gray and the door graphic is gray and is shown closed when the door is locked and secured.
 - 2. The Door Icon is gray and the door graphic is red when the door is powered and opened.
 - 3. The Door Icon is gray and the door graphic is fast flashing red when the door is breached or manually opened.
 - 4. The Door Icon is gray and the door graphic is slow flashing red when the door alarm has been acknowledged by the operator.
 - 5. The Door Icon is gray again and the door graphic is gray again when the door has been reset by the operator.
 - 6. If there is a camera associated with door in alarm it shall be displayed on the call up monitor and the Camera Icon shall change to red.

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- E. Interlocked doors are bordered around their Icons in yellow when a door in a designated interlock group is unsecured. If two interlocked doors are attempted to be unlocked at the same time, a pop up warning shall display on the screen along with a voice announcement.
- 1.9 DOOR SHUNT
- A. Each controlled or monitored door will have the ability for the door breach alarm to be shunted. The door breach alarm does not alarm to the graphical user interface when the door has been shunted.
 - B. The door shunting feature shall be configurable by individual door by a supervisor level user.
 - C. Door icon shall display an "S", a change in color, or similar graphic change to signify when the alarms are shunted.
- 1.10 HOLD OPEN
- A. Selecting the Hold Open Icon in the FCB will unlock the door and keep it electrically unlocked until the operator selects the Door Icon only. The Function Icon in the FCB shall stay illuminated during the three second selection process.
- 1.11 DOOR ISOLATE
- A. Electrically controlled doors or doors that are controlled by card readers can be isolated so that they cannot be opened. To isolate a door the operator selects the Door Isolate Icon in the FCB and then selects the Door Icon. Other doors can be isolated within three seconds of the first. After three seconds the Door Isolate function cancels. Repeating the process on the same Door Icon will reverse the condition. When a door is isolated the Door Icon will have a black "X" over it indicating the door cannot be opened. If an operator attempts to unlock an isolated door, a pop up warning shall display on the screen along with a voice announcement.
- 1.12 EMERGENCY RELEASE
- A. There shall be an "Emergency Evac" button located in the FCB. This button shall be placed on the screen in a location where the Operator is least likely to accidentally press it. When the operator selects this button a pop up screen shall ask the operator if they would like to continue. If the operator selects the "Yes" button (s)he will be able to emergency release doors by selecting the door icons on the display map. Opening the doors shall be a single step approach during an emergency release. The door icon shall flash red to acknowledge it has been opened. The doors shall remain unlocked until the operator cancels the emergency release function. Isolated doors shall become available to unlock in the emergency release. To relock the doors after an emergency release, the operator shall select "emergency evac" button again which will cycle the door locks to allow them to be closed/secured.
- 1.13 GROUP RELEASE
- A. Each housing area shall have a group release button. This button shall be programed to work as a 2-step process (unlock + group release, or group release + confirmation pop up) that will open all cell doors in that housing area that are not isolated.

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1.14 EXTERIOR DOOR

- A. All doors to the exterior of the building and the exterior of the secure perimeter shall have an additional step to unlock the door. The normal sequence of pressing the unlock button on FCB and then the door icon shall activate a pop-up box confirming that this door is an exterior door.

1.15 INTERLOCK OVERRIDE

- A. In the FCB, the unlock override button shall require confirmation (“yes” or “no”) in addition to the two-step unlock process to open an interlocked door.

1.16 INTERCOM

- A. Establishing audio communication at the VGUI with the remote intercom station shall be accomplished by either selecting the Intercom Icon on the Map Display or selecting the intercom call in the Pending Call List Display located below the site map.
 - 1. When a station or speaker is off, the icon shall be gray.
 - 2. When a station or speaker initiates a call to the VGUI control station, the icon shall flash green and be accompanied by a distinctive audible tone or voice announcement.
 - 3. When the operator selects the Intercom call the station or speaker shall turn on. When a station or speaker is on, the icon shall turn solid green and the audible tone or voice announcement associated with the call shall be off.
 - 4. A camera shall always be called up for view when a call is selected and the associated camera icon shall turn green to show its correlation to the intercom call. Intercom shall call up the nearest camera with the best view of who is standing at the intercom. Any locations without a camera with a direct view shall call up a camera that is closest to it to help show at least the general area.

1.17 ISOLATE INTERCOM

- A. This feature shall allow the operator to turn off an intercom station. Incoming calls will still be received and the Intercom Icon on the Display map will still flash a green color, but no voice announcement will be given and the operator will not have to answer the call. The operator shall select the Icon Isolate Icon in the FCB and then the Intercom Icon in the Map Display and the Intercom Icon in the Map Display will have a black “X” over it indicating it has been isolated. Repeating the process will reverse the Intercom Isolate.
- B. This feature shall only be available for supervisor level users.

1.18 PAGE

- A. This function allows the operator to select one or more paging zones for a paging announcement. The operator will select the Page Icon in the Map Display. The Page Icon will change to a green color during the paging operation and back to gray when the paging operation is completed.

1.19 ALL PAGE

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- A. The FCB shall allow the operator to perform a paging operation in the entire facility. This function shall also include all intercom stations.
- 1.20 VIDEO
- A. Establish video communications at the VGUI with a VMS camera. Operator shall accomplish by selecting a Camera Icon in the Map Display.
 - 1. Upon selection of a Camera Icon the Camera Icon will turn blue and the VMS image will be displayed on the video monitor at the operator station. Camera call up shall take less than 2 seconds and shall be live video without any time delay.
 - 2. Selecting the Camera Icon again shall cancel the video and return the Camera Icon to its gray color. The video monitor shall be black.
- 1.21 DURESS ALARM
- A. When a duress alarm is activated the duress alarm icon on the screen shall flash red and there shall be a voice announcement alerting the operator that there is a duress alarm. If there is a camera associated with the duress alarm the camera shall be automatically displayed on the spot monitor at the operator station.
- 1.22 UPS ALARMS
- A. Each UPS shall provide dry contact outputs to the security system for monitoring at the VGUI station. The VGUI station shall indicate when the UPS has low battery and trouble.
- 1.23 EMERGENCY GENERATOR
- A. The emergency generator shall provide three dry contact outputs to the security control system for monitoring at the VGUI station. Coordinate division of responsibility of all conduit, wiring and terminations with generator provider.
- 1.24 PLC FAULT, LOW BATTERY
- A. Each PLC within the system shall provide dry contact outputs to the security system for monitoring at the VGUI station. The VGUI station shall indicate when the PLC has low battery and fault conditions.
- 1.25 ALARM OCCURRENCE LOG: Each time an alarm comes into the system, the Occurrence Log shall provide a text-based entry system required for operators to log events or notes related to the alarm before the alarm can be reset. Provide a "screen" for the Owner to customize by alarm type which alarms require a mandatory response before being reset. This list shall only be edited by admin level users in a check yes or no format.
- A. Entry of new occurrence logs
 - 1. The operator shall enter text via the attached keyboard or option of using the software keyboard. The software keyboard shall include all standard keys including, shift, caps lock, backspace, enter, and arrow keys. As characters are selected on the keyboard they should be displayed in the appropriate field. The software keyboard shall have a CLOSE button.

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2. The operator shall select the SUBMIT button to save the entered text to the SMS. After submitted, status should indicate that the text has been sent and saved successfully, and the title and log fields should be cleared. If the text is not sent and saved successfully, the status should indicate "Log Entry Failed," and the title and log fields should not be cleared. The operator shall select the CLEAR button to clear the title and log fields.
 3. The operator shall select the VIEW LOG BOOK button to view previous entries of that specific VGUI station within the last 24 hours.
 4. The Occurrence Log entry shall be capable of 3800 characters.
- B. Viewing previous entries
1. The operator shall be capable of displaying up to 100 logged entries at the VGUI.
 2. The operator shall select the NEW LOG ENTRY button to return to the new occurrence log entry screen.
- C. All data shall be logged to SMS.
- 1.26 CARD READER ISOLATE
- A. Each card reader throughout the facility shall be able to be isolated from the VGUI station. To isolate the card reader, the operator selects the "card reader isolate" icon and within three seconds the card reader button the operator would like to isolate.
 - B. The card reader icon will have a black "X" over the reader indicating that the reader is isolated. Isolated readers cannot be used for movement through a door while the reader is isolated."
- 1.27 SECURITY MANAGEMENT SYSTEM
- A. The system shall record all of the previously mentioned operations activity to allow for automated sorting and report generation. Refer to Section 285900.

PART 2 - PRODUCTS

2.1 COMPUTERS:

- A. Video Graphical User Interface (VGUI) shall consist of PC-based workstations providing the minimum distributed processing capability as per the following.
 1. Intel Core i5-4570 quad core, 3.2GHz turbo processor or better, 512K cache, 8GB 1600MHz DD3 Memory, 250GB SSD hard drive, 2 USB ports, network card for Ethernet operation, CD-ROM drive, sound card, video accelerator, running Windows 11 pro. Provide UPS power for all workstations.
 2. Size CPU housing in Small Form Factor or as required to fit the console/casework in which it will be located.
 3. This spec shall be exceeded as necessary when multiple systems are combined onto one station.
 4. Approved Manufacturers:
 - a. HP
 - b. Dell

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c. IBM

2.2 MONITORS

- A. Provide for each Central Control VGUI operator station a 24" LCD flat panel touch screen with 1920 X 1080 pixel resolution as indicated on the Drawings.
- B. Approved Manufacturers – Dell, Samsung, NEC, HP

2.3 MONITOR ARMS

- A. Provide monitor arms for all monitors placed on casework. Arms shall be able to tilt, swivel, pan and rotate.
- B. Desktop monitor arms shall have enough range to allow the top of the monitor to be angled back greater than 45° while the bottom of the monitor is flush or within half an inch to the desktop surface. Provide all required hardware/mounting kits to permanently mount the arms to the desktop surface. Coordinate placement prior to installation.
- C. Approved Manufacturers – Egrotron, approved equal.

2.4 CONTROL STATION AUDIO COMPONENTS

- A. Provide the following audio components for each VGUI station indicated on the drawings.
 - 1. Desktop Microphone unit with PTT (push to talk) button to allow the user to communicate on the audio system. Microphone levels shall be adjustable from the VGUI station.
 - a. Condenser Microphone:
 - 1) Sensitivity: 1.3 mV/Pa
 - 2) Impedance: 1000Ω
 - 3) Frequency: 50-16,000 Hz
 - 4) Operation voltage: 5V via USB
 - 5) S/N ratio: More than 60dB
 - b. Provide push-to-talk push button with 6' cord, flange base with mounting holes and an audible click feedback.
 - c. Provide impedance adapter for proper audio level interface between sound card on VGUI control station PC and remote intercom amplifier.
 - d. Desktop microphone shall be Audix USB12 or approved equal.
 - 2. Desktop speakers to allow the user to hear communications from the audio system. Volume level shall be adjustable from both the speakers and VGUI station. Desktop speakers shall be Dell AX210 or approved equal.
 - 3. At SCSC's option, a desktop intercom station may be substituted for the desktop microphone and speakers at each VGUI station. Desktop intercom station shall be a vandal-resistant loudspeaker/ microphone assembly with push-to-talk (PTT) button switch and gooseneck microphone. Approved models:
 - a. Available Products: Subject to compliance with requirements , provide one of the following products:
 - 1) Harding TMM-440
 - 2) Jeron 4349
 - 3) Quam DTS1

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4. Provide a single gang wall-plate for mounting to a 3-1/2" deep back box. Wall-plate shall include stereo-type jacks for microphone, speaker and push-to-talk button. Wall-plate shall include RJ-45 jack for Ethernet communications between VGUI control station PC and PLC System Ethernet network.
5. Source Limitations: Obtain each type of desktop audio component from single manufacturer and provide same components for all VGUI stations.

2.5 TOUCHSCREEN OVERLAYS:

- A. Touchscreen overlays shall be of the analog capacitive technology with 1024 touch points resolution. Linearity shall be less than +/- 1% error with a drift offset of no worse than +/- .5% anywhere on the screen. Mean Time Between Failures (MTBF per MIL-HANDBOOK-217D) for the controller shall be greater than 176,000 hours and a touch life in any one location of 20 million touches. Connection from the Touchscreen to the computer shall be bi-directional asynchronous RS-232C or Universal Serial Bus (USB). The Touchscreen driver shall allow the touch area to activate upon release from the Touchscreen only. Commonly called liftoff mode.
 1. 3M Touch Systems (Microtouch)
 2. ELO

2.6 VIDEO GRAPHIC USER INTERFACE

- A. VGUI Configuration Software: The configuration software must be compatible with the PLC programming software. The VGUI stations are primarily for operator interface only. Critical control functions, such as door control, duress, and utility control are to be executed by the PLC CPU program(s).
- B. Acceptable manufacturers:
 1. Wonderware InTouch
- C. All software shall be licensed (registered) to the Owner. Each operator station regardless of size shall be provided with an unlimited tag software package.
- D. The SCSC shall turn over to the Owner all programming passwords, source codes, backup copy on CD or USB drive of all software programs, runtime and programming licenses and programming schedules at the end of the project.

PART 3 - EXECUTION

3.1 SOFTWARE REVIEW:

- A. Refer to Section 285000 for Software Meeting Requirements.

END OF SECTION 285020

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SECTION 285030 – CABINETS AND ENCLOSURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this section.

1.2 DESCRIPTION OF WORK

- A. Provide all material and labor for all cabinets and enclosures required by the security control system for this project.
- B. Provide all connection accessories to make this a full working system. All fittings, extenders, and supplementary items shall be provided for a complete and security installation.

1.3 SUMMARY

- A. Provide cabinets and enclosures for the protection and security of the equipment contained within the cabinet or enclosure.
- B. All cabinets and enclosures shall be rated for the space within which they are installed unless noted otherwise.
 - 1. Type 1: Indoor use - protect against contact with equipment located inside and protect against dirt and dust.
 - 2. Type 3: Outdoor use – protect against windblown dust and rain, and protect against formation of ice on the enclosure
 - 3. Type 3R: Outdoor use - protect against windblown dust and rain, and protect against formation of ice on the enclosure
 - 4. Type 4: Indoor or Outdoor use – protect against falling rain, splashing water and protect against the formation of ice on the enclosure.
 - 5. Type 4X: Indoor or Outdoor use - protect against falling rain, splashing water and protect against the formation of ice on the enclosure; resists corrosion
 - 6. Type 12: Indoor use: provide protection against dust, dirt, fiber, dripping water, and condensation of non-corrosive liquids.
- C. Refer to other Div 28 sections for cabling, installation, identification and termination requirements.

1.4 SUBMITTALS

- A. Provide all product data for the cabinets and enclosures provided on this project.
- B. Provide cabinet and enclosure layouts of all security control system rooms. Provide all elevations and floor plans with dimensions indicating size of enclosures and clearances required.
- C. Provide cabinet and enclosure temperature testing results.

1.5 GUARANTEE

- A. The SCSC shall guarantee all equipment for a period of two (2) years commencing with Substantial Completion. The guarantee shall cover all costs for Warranty Services, including parts,

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labor, prompt field service, pick-up and transportation. All manufacturers' warranties shall be passed onto the Owner beyond the warranty period.

PART 2 - PRODUCTS

2.1 GENERAL

A. Cabinet & Enclosures for Security Equipment

1. Acceptable Manufacturers
 - a. Atlas Soundolier
 - b. Eldon
 - c. Hoffman
 - d. Middle Atlantic Products, Inc.
 - e. Winsted

B. Cabinet & Enclosures for Server Equipment

1. Acceptable Manufacturers
 - a. HP (10642G2)
 - b. APC (AR3100)
 - c. Belkin (RK1000)
 - d. Dell (Startech RK4242BK0)
 - e. Chatsworth (GF-1A320)

2.2 MATERIALS

A. Cabinets

1. Cold Rolled steel units, 12 Ga angles, 14 Ga posts, 16 Ga molding and braces.
2. 16 Ga flush mount doors; flush or louvered with flush pulls
3. 16 Ga flush mount; flush or louvered, easy removal.
4. Provide door with key lock on all cabinets.
5. Provide louvers as required for cooling equipment.
6. Provide ventilation fans to maintain manufacturer recommended temperatures for equipment.
7. Provide electrical outlet and power strip for power supplies. Install wire ties around plugs to prevent the plug from being removed accidentally.
8. Floor Mounted Units
 - a. Door Control & Video Equipment Cabinets: Nominal 30" deep x 30" wide; 72-90" high; 24" EIA rack mounting frames
 - b. Intercom & Paging Equipment Cabinets: Nominal 30" deep x 24" wide' 72-90" high; 19" EIA rack mounting frames
 - c. Provide blank plates on all unused areas of the cabinet.
9. Wall Mounted Units
 - a. Provide only in room locations with size restrictions that would prevent the use of floor mounted units with proper NEC clearance from front and rear.

B. Enclosures

1. Provide wall mounted equipment as need in security control system rooms.
2. Provide hinged door with keyed lock.

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3. Provide ventilation fans to maintain manufacturer recommended temperatures for equipment.

2.3 FABRICATION

- A. Install enclosures to easily accommodate interconnecting cables from above or below through the use of cable trays or conduits.
- B. Combine wires/cables by types and boards. Provide installation meeting National Electrical Code clearances, cabling installation and circuit separation requirements.
- C. Organize all wiring and cable routing by device types. Provide cabling support and tie up throughout the cabinet to provide a clean installation.
- D. No splices permitted from field device to head end connection.
- E. Provide grounding of all equipment as required by NEC.
- F. Provide protection from contact of terminals and exposed conductors.
- G. Provide din rail and mounting equipment for all applications. All equipment shall be accessible from each side of the cabinet as needed. Do not block access to required equipment to be maintained.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Check location, "roughing in", and field dimensions prior to beginning work.
- B. Do not begin installation until all unsatisfactory conditions have been corrected.
- C. Verify field measurements are as shown on Drawings and as instructed by manufacturer.
- D. Verify that required utilities are available, in proper location, and ready for use.

3.2 INSTALLATION/APPLICATION OF ALL SECURITY PRODUCTS

- A. Provide wire management throughout cabinets and enclosures.
- B. Replace equipment, components, & wiring as required to achieve a fully functional system.

END OF SECTION 285030

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SECTION 285100 – AUDIO COMMUNICATION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this section.

1.2 SUMMARY

- A. This section includes the requirements and operational characteristics for an Audio Communication System, which is an integral part of the Security Control System. Audio Communication systems included are:
1. Remote intercom stations, ceiling-mounted speaker assemblies and speaker horns.
 2. Audio system head-end and control components utilizing Zenitel
 3. General and Emergency Paging components.
 4. VGUI control station audio components.
- B. All components used in creating the communication system shall be of the same manufacturer and/or approved by the manufacturer for system compatibility. Equipment and specified herein is for the purpose of establishing the types of equipment and the minimum quality of equipment required. It shall be the Security Control System Contractors responsibility to assure the compatibility of all access control equipment, software, programming, cable, mounting methods, etc. that are used in providing a complete system.
- C. Provide a PLC-controlled, facility-wide, digital audio communication system, which is fully integrated with the Security Control System. This system shall provide two-way, remote reply intercommunication between VGUI control station(s) and users and remote intercom stations, speakers, and horns. This system shall allow any remote intercom station or ceiling monitoring speaker to be answered by the VGUI control station in primary control of that particular area, or by the VGUI control station(s) in Central Control.
- D. The audio system will be free from any ‘popping’, ‘cracking’ or ‘humming’ at all times. Audio annunciated at the control station shall be of sufficient quality that voice or other common sounds can be correctly interpreted at a distance of 2-4’ directly in front of the VGUI system.
- E. Each VGUI control station shall have its own dedicated talk path to all devices under its control. Sharing of talk paths between VGUI control stations will not be accepted. System shall provide for call forwarding/takeover from one VGUI control station to another after an owner specified time.
- F. The audio communication system shall interface with the VMS system via the PLC System.
- G. Each remote intercom station or ceiling monitoring speaker shall be annunciated on any VGUI control station in primary control of that intercom station or speaker’s area.
- H. Provide an audible feedback tone at each intercom station to indicate to the user that the push button has activated a call in function.
- I. The remote intercom station or ceiling monitoring speaker’s audio shall be driven through the VGUI control station computer speakers or a stand-alone intercom master station Use a desktop intercom master station at locations without VGUI control. Audio from the VGUI control station microphone to the remote intercom station or ceiling speaker shall only be active while the VGUI control station push-to-talk push button is depressed.

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- J. Each station's volume level shall be independently software controlled. Level settings shall remain in effect until modified by a future adjustment.
- K. The paging system shall have the capability of reaching individual areas of the facility, or the entire facility.
- L. Paging zones shall be grouped logically, and final zone configuration shall be coordinated with the architect and owner during the submittal phase.
- M. Intercoms shall be able to be included in paging zones.
- N. Remote intercom stations and ceiling monitoring speakers shall be programmed to call the intercom master station that is in control of that local area. If local control is transferred or the call is not answered within a preselected number of rings or predefined length of time, the call shall be automatically forwarded to the Central VGUI control station. Calls assigned to the local intercom master stations will not show up on the Central VGUI control station until such calls are forwarded to the VGUI control station.
- O. Acceptable Manufacturer:
 - 1. Zenitel
- P. Provide a talk-thru communication system, which shall provide a two-way, hands-free duplex audio communications link between a partition.

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. Remote Intercom Station
 - 1. Intercom stations shall be designed for mounting on standard 2-gang outlet boxes. Faceplates to be constructed of 11 gauge brushed stainless. Internal steel offset grille to restrict inserting objects through speaker grille. Stations shall be ruggedly constructed and resistant to damage from soil and sprays.
 - 2. Each intercom station shall incorporate an internal loudspeaker, microphone preamplifier and multiplexing circuitry. One pushbutton shall be provided on each station.
 - 3. Pushbuttons shall be single piece stainless steel construction and shall be backstopped to prevent excessive travel. Switch shall have positive tactile action with 1 million-operation lifetime.
 - 4. Loudspeakers shall be waterproof mylar cone type.
 - 5. Provide weatherproof remote intercom station when the station is located outside. Outdoor intercom stations are to be identical in all respects to standard intercom stations except that all metal plates and hardware to be stainless steel, and internal circuitry and components to be conformal coated.
 - 6. The remote intercom station shall be a Zenitel.
- B. Inmate Emergency Call-In Station (Located inside Sleeping and Holding rooms)
 - 1. Shall be flush mounted in the wall or hollow metal frame jamb of the cell, 18" AFF as shown on drawings.
 - 2. Shall utilize push button call activation to the appropriate intercom master station.
 - 3. Inmate Emergency Call-in Station shall comply with the specifications for Remote Intercom Stations.
- C. Call Switch

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1. As indicated on contract documents, provide Call Switches made of 11ga stainless steel, with vandal resistant switch that is made to mount to single gang electrical box.
 2. Call Switch shall call into the intercom call list like an intercom.
 3. The Call Switch shall be Quam CIB2 or approved equal.
- D. Drive-up Intercom/camera Pedestal
1. Provide and install intercom/camera pedestal. SCSC is responsible for coordinating all conduit, wiring, terminations, and surge protection with Division 26 to make this a working system.
 2. Unit shall be constructed per detail on Drawing SE3.1.
 3. Material shall be 12 gauge cold rolled steel, powder coated. Coordinate color during submittal phase.
 4. Unit shall be mounted per the detail on Drawing SE3.1.
- E. Drive-up Intercom Buried Detection Loop:
1. Series/Manufacturer:
 - a. EMX Industries, Inc., Cleveland, OH
 - b. Marsh Products; Batavia, IL
 - c. U. S. Traffic Corp.; Santa Fe Springs, CA
 2. Description:
 - a. Unless otherwise noted, the buried vehicle detection loop shall detect the approach of a car or van to the overhead door (or gate) and alert Central Control with a flashing icon and voice annunciation that a vehicle is waiting to enter/exit. Locations with intercom stanchion may act as an intercom call while locations without an intercom are to act as a "call-in" button. Provide a different alert tone/voice to help separate this from other call-ins. Selection of these alerts shall display the adjacent camera video. The VGUI operator shall be able to confirm the vehicle on the call-up monitor and open/close the door.
 - b. The detection loop shall not be activated by a pedestrian and/or by bicycles.
 - c. The detection loop shall utilize a magnetic field for sensing motion of ferrous metal objects.
 - d. The detection loop shall operate within the temperature range of -50 degrees to +140 degrees F.
- F. Paging Speaker Assembly
1. Ceiling and Wall mounted speaker assemblies shall consist of a Lowell 8C10W-25 speaker, a Lowell SQLK-8 baffle and a Lowell P875X back box for recessed-mount applications and Lowell CB84 back box for surface-mount applications. Exterior applications shall use assemblies rated for exterior use such as the Quam System 6VPS. Approved manufacturer; Quam, Lowell, or approved equal.
- G. Relay Selection Panel
1. The relay selection panel shall provide individual relay control of speaker lines for paging. Provide all required PLC outputs for interface to relay selection panel(s) for a fully-functional audio communications system.
 2. The panel shall contain one control circuit per speaker line that shall provide for the selection of any line. The panel shall provide a common audio input for all speaker lines. The panel shall contain relays that operate to connect the common audio input with the

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appropriate speaker lines as controlled by the intercom control circuits. The panel shall contain a program bus that shall provide for program distribution to all speaker lines.

3. The relays shall be of sealed type construction with a life expectancy of 10,000,000 operations. Relay contacts shall be rated at 2A. Less than 0.75A at 24Vdc shall be required to operate up to 25 relays simultaneously.
4. All wire connectors to the panel shall be to insulation displacement connectors. The connectors shall accommodate 22 AWG for speaker line connections and 18 AWG for audio input connections.

H. Paging Amplifier

1. Provide quantity required to support the number of field devices to be supported.
2. The paging amplifier shall be mounted in a standard 19-inch rack.
3. The paging amplifier shall be a TOA model P-906MK2 or P-912MK2 or approved equal, depending on power requirements of installed equipment.

I. VGUI Control Station Audio Components

1. Refer to Section 285020 for Control Station Audio Components.

J. Desktop Intercom Master Station

1. Desktop intercom master stations shall be used in locations that do not have VGUI control systems.
2. Desktop intercom master stations to consist of display, keypads, internal speaker/microphone, telephone handset with hook switch, headset jack, and external buzzer contacts.
3. The display module to consist of 4 line by 20-character alphanumeric LCD display mounted behind a brushed stainless steel faceplate. Display is to include a scratch and impact resistant window, adjustable viewing angle, and adjustable back lighting. Character size 0.19" H x 0.12" W.
4. Five function keys to be provided below the display to enter menu selections. Function key action to be labeled on display and vary according to location in the menu structure and current options available.
5. Separate 19 button keypad to include standard 12 numeric keypad keys, two scroll keys, enter key, clear key, headset key, mute key, and press-to-talk key.
6. Key switch lifetime for all keys, 10 million operations.
7. Telephone handset with coiled cord, press-to-talk bar, and hook switch cradle to be mounted on side of master station. Lifting handset from hook switch automatically disconnect loudspeaker/microphone communications.
8. Desktop mounted intercom master station top housing assembly to be fabricated with single piece, brushed stainless steel, slope-faced faceplate. Rear, bottom, and side panels to be single piece formed steel with welded joints and matte black finish. Overall housing dimensions, excluding rubber feet, 9.5" W x 10.25" D x 4.5" H.
9. Provide quantity of intercom master stations as indicated on the Drawings.

K. Talk-thru Communicator

1. The talk-thru communicator shall provide a two-way, hands-free duplex audio communications between a partition.
2. The talk-thru communicator shall contain two voice channels, each incorporating a microphone amplifier, VOX switch, compressor, background noise monitor, attenuator controls, level detectors, and a bridge amplifier.
3. The sound amplifier shall not exceed 0.2% THD.

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4. The talk-thru communicator shall include an operator-side gooseneck microphone, power on/off switch, power-on green LED, "talk" volume control and "listen" volume control. The exterior shall be equipped with a 2 ¼" ferrite, magnetic speaker and electret microphone. An AC adapter, which steps down 120VAC to 18VDC shall be provided.
 5. The Type 1 talk-thru communicator (TTC-1) shall incorporate a Class II bullet-resistive insert, being able to withstand a standard bullet from a .357 Magnum firearm.
 6. The SCSC shall coordinate with the partition or glass provider for the appropriate cutout size for the Type 1 unit. The Division 26 contractor shall provide local 120VAC power for each unit.
 7. Type 1 Talk-thru communicators (TTC-1) shall be equivalent to Haven Technology model #SC-100, or approved equal.
 8. Type 2 Talk-thru communicators (TTC-2) shall be equivalent to Haven Technology model #SC-300, or approved equal.
 9. Installation: Coordinate with hollow metal manufacturer, and construction document details to provide installation into the hollow metal frame section with concealed conduit for the supply of its operating power. Provide low-voltage power to the TTC from the Security Electronics equipment room.
- L. Talk-Through Intercom Unit (TTU): (Located at Visitation rooms; refer to Drawings for locations and quantities.)
1. Series/Manufacturer
 - b. TTU-5/Norcon Comm. Inc.; Inwood L.I., New York
 - c. SC-600/HAVEN Technology Corp.; Corona, CA
 2. Function
 - a. Hands-free two-way conversations.
 - b. Unit shall be bullet resistant with stainless steel faces.
 3. Components
 - a. Outside faceplate shall be approximately 13" H x 4 ½" W stainless steel with Torx-head security fasteners with center reject pin.
 - b. Back-boxes shall be 11 ½" H x 3 ½" W x 2" D.
 - c. Electronic assembly shall have as a minimum the following:
 1. Audio power: 2 watts
 2. Distortion: Less than 2%
 3. Listen Mode: 20 dB compression
 4. Talk Mode: Automatic call voice controlled (VOX)
 5. Microphones: "Electret"
 6. Power source: Line voltage in concealed wall conduit
 7. Power Supply: Input: 120 VAC, 60 Hz, Output: 15 VDC, 175 mA
 4. Installation: Coordinate with hollow metal manufacturer, and construction document details to provide installation into the hollow metal frame section with concealed conduit for the supply of its operating power. Provide low-voltage power to the TTU from the Security Electronics equipment room.
- M. Video Intercom System
1. Manufacturer
 - a. Aiphone JP Series
 - b. Approved equal.
 2. Master Station – Aiphone JP-4MED or approved equal.
 3. Door Station – Aiphone JP-DV, or approved equal.

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- N. Spares:
 - 1. Refer to Section 285000.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces and areas are ready to receive work.
- B. Verify field measurements are as shown on Drawings and as instructed by manufacturer.
- C. Verify that required utilities are available, in proper location, and ready for use.

3.2 INSTALLATION

- A. All system equipment to be contained within equipment racks, cabinets, or closets. If more or larger equipment racks or cabinets are required than exist or are indicated on the drawings, allow for such additional equipment racks and cabinets in contract price.
- B. All system equipment equipped with plug in power connectors to be connected to a dedicated receptacle. Do not use tap connectors for plugging in multiple plugs into a single receptacle.
- C. All cable within equipment racks, cupboards, and cabinets, or on backboards, to be neatly bundled and secured. Wires shall not be nicked, have strands removed, or have frayed strands when removing insulation or terminating.
- D. Factory manufactured interface cables to be provided for each field interface board. Terminal blocks to be provided in cabinet or on backboard for factory cable interface to field wiring.
- E. Wiring shall be executed in strict adherence to standard broadcast practices.
- F. Identify wiring by continuous insulation color. Where multi-conductor cables are used, use the same color-coding system for identification of wiring throughout.
- G. Maintain uniform phasing and color-coding throughout system.
- H. Name identification of wiring:
 - 1. Identify wiring at all equipment locations, pull boxes, junction boxes and outlet boxes.
 - 2. Develop a uniform identification scheme for use throughout the system.
 - 3. Record wire name identification on all applicable drawings and provide wiring tables within the operating and installation manuals.
- I. Use one of the following marking materials:
 - 1. Heat shrink sleeves.
 - 2. Clear plastic tape wrap-on strips with designated labeling section.
 - 3. Slip-on identification bead markers or sleeves.
- J. Replace equipment, components, and wiring as required to achieve a fully functional system.

END OF SECTION 285100

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SECTION 285200 - VIDEO SURVEILLANCE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this section.

1.2 WORK IN THIS SECTION:

- A. The system shall consist of IP cameras, lenses, and monitors, mounting hardware, housings, network video servers, Video Data Storage Equipment, and Client workstations with software for live and recorded image viewing.
- B. The system shall permit visual monitoring and surveillance of selected areas automatically based on events via the PLC for intercom and duress stations.
- C. Provide video integration at all VGUI locations as per spec section 285020.
- D. Exterior cameras in areas of low light shall be inclusive of IR or low light capabilities to produce a clearly identifiable image when viewed.

1.3 QUALITY ASSURANCE

- A. NEC Compliance. Comply with applicable requirements pertaining to TV equipment and signal distribution systems
- B. UL Compliance. Comply with applicable requirements of UL safety standards pertaining to television equipment and accessories. Provide TV equipment and accessories, which are UL-listed and labeled.
- C. EIA Compliance. Comply with applicable requirements of Electronic Industries Associations standards pertaining to television cameras and monitors.

1.4 SYSTEM DESCRIPTION

- A. The system shall provide for the visual surveillance of all camera locations from the VGUI operator station.
- B. The system shall be integrated with the VGUI to allow events to affect the camera callup.
- C. Selected monitors shall have multiple screen display mode with selectable outputs.
- D. Controls shall allow manual selection of any camera display option.
- E. The system shall allow full frame rate (30fps) and full resolution (1080p HD) live viewing on all camera inputs and simultaneous recording at a lower frame rate and/or resolution to manage the use of storage space.
- F. Provide Power over Ethernet (PoE) for all cameras within the system.
- G. The system shall support JPEG, H.264, MJPEG, MPEG-2, MPEG-4, and be configurable on a per camera basis.
- H. Proprietary hardware or installation of video capture cards shall not be allowed.
- I. The system shall utilize TCP/IP communication protocols and reside on an Ethernet LAN physical layer.

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- J. Client workstations shall be configured with dual monitor outputs to support multiple live and recorded views. Each monitor shall be capable of 16 images simultaneously.
- K. All cameras shall have vandal resistant grade housings.

PART 2 - PRODUCTS

2.1 GENERAL DESCRIPTION:

- A. Subject to compliance with the requirements to provide equipment from the manufacturer listed herein or an approved equivalent.

2.2 MONITORS

- A. Provide 24" HD LED Monitors that meet the following requirements:
 - 1. Digital resolution of up to 1920 x 1080 pixels.
 - 2. HDMI, DVI, and VGA inputs.
 - 3. Built-in speaker.
 - 4. Connections for video and audio input/outputs.
 - 5. On-screen display for setup and adjustment of the monitor viewing parameters.
 - 6. NTSC/PAL standards compliant.
 - 7. Equipped with base for placing the unit on a flat surface.
 - 8. Tint, color, brightness, contrast, volume, and power on/off controls.
 - 9. Black plastic cabinet with a black matte finish.
- B. Manufacturer:
 - 1. Bosch
 - 2. Hanwha
 - 3. Pelco
 - 4. Sony
 - 5. Vicon
 - 6. Approved Equal

2.3 MONITOR ARMS

- A. Provide monitor arms for all monitors being mounted on casework. Arms shall be able to tilt, swivel, pan and rotate.
- B. Desktop monitor arms shall have enough range to allow the top of the monitor to be angled back greater than 45° while the bottom of the monitor is flush or within half an inch to the desktop surface. Provide all required hardware/mounting kits to permanently mount the arms to the desktop surface. Coordinate placement prior to installation.
- C. Approved Manufacturers – Egrotron, approved equal.

2.4 INTERIOR / EXTERIOR FIXED DOME IP CAMERAS

- A. The indoor fixed camera dome shall incorporate a fixed camera/lens combination. The camera dome shall be available for indoor surface mounting. The high-resolution day/night camera shall be available with an integral 3.3-12 mm or 9-22 mm varifocal autoiris lens. The lenses

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shall be available motorized to allow for remote configuration of zoom and focus (motorized focus and zoom - MFZ); it shall be zoom scalable so the iris shall automatically adjust to zoom condition. Day/night operation shall be achieved using a built-in IR-cut filter. A smoke polycarbonate lower dome that is secured by tamperproof screws shall be included. Exterior cameras shall have black housings. Interior camera housings shall be lighter in color to be coordinated during the submittal phase.

- B. The latest model available from the camera manufacturer shall be utilized.
- C. The camera position shall have a three-direction adjustment, allowing for adjustment of pan, tilt and lens rotation (roll), for any angle of view required.
- D. The camera dome shall be powered by PoE, 24 VAC or 12 VDC.
- E. The camera dome shall have dual streaming video and support H.264 and M-JPEG (2nd stream only) compression.
- F. Camera features shall include electronic iris, WDR, AGC, BLC, white balance, flip, mirror and motion detection.
- G. The camera dome shall meet the FCC requirements for a Class A device. It shall include support for the industry-standard ONVIF interface.
- H. The camera dome shall provide a slot for an SD card for local storage.
- I. Cameras shall be Color with a UL listing.
 - 1. Imaging sensor: 1/2.5" CMOS Sensor
 - 2. Lens: Varifocal 3.3 -12mm or 9 – 22mm
 - 3. For cameras indicated as wide-angle lens cameras, provide wide-angle lens ranging between 1.8 to 3 mm.
 - 4. Electronic Zoom: 2-10x (based on client software)
 - 5. Minimum illumination: Color 0.07fc, B&W 0.007fc
 - 6. Video compression: H.264 with MPEG-4 available on 2nd stream
 - 7. Casing: impact-resistant casing and polycarbonate smoked dome
 - 8. Resolution: 1080P
 - 9. Frame Rate: 2.5 – 30fps
 - 10. Power: camera: PoE (IEEE 802.3af) class 2
 - 11. Operating Temperature: with heater: (-20 – 122deg F)
 - 12. Supported protocols: HTTP, HTTPS, TCP, RTSP/RTP/RTCP, IGMP, SMTP, IPv4, IPv6, DHCP, NTP, ARP, DNS
- J. Acceptable Manufacturers
 - 1. Axis

2.5 EXTERIOR/INTERIOR 180°, 270°, 360° MULTI-LENS IP CAMERAS

- A. Megapixel camera with true Day/Night functionality (mechanical IR cut filter), POE and Auxiliary powered, with adjustable 2 axis camera gimbals for 360° pan and 90° tilt, privacy mask, motion detection, bit rate control and multi-streaming.
- B. The latest model available from the camera manufacturer shall be utilized. Provide mounting equipment as needed.

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- C. Cameras shall be Color with a UL listing.
 - 1. Image Sensor: 12MP = 3MPx4
 - 2. Optical Format: 1/3.2"
 - 3. Lens: (4) F1.6, 8.0 mm, IRH-FOV: 88°
 - 4. Electronic Zoom
 - 5. Minimum illumination: Color: 0.25 lux
 - 6. Video compression: H.264 with MPEG-4 available on 2nd stream
 - 7. Outdoor rated IP66 and IK-10 impact-resistant housing and polycarbonate dome.
 - 8. Frame Rates: Full resolution: 5.2fps (8192 x1536), 1/4 resolution: 17fps (2048x1536)
 - 9. Power: camera: PoE class 3
 - 10. Operating Temperature: with heater: -40° F to 122° F
 - 11. Supported protocols: RTSP, RTP/TCP, RTP/UDP, HTTP, DHCP, TFTP.
- D. Acceptable Manufacturers:
 - 1. Axis

2.6 EXTERIOR/INTERIOR PTZ DOME IP CAMERAS

- A. The latest model available from the camera manufacturer shall be utilized.
- B. The compact network dome shall be comprised of a camera/lens and pan/tilt drive in an enclosure.
- C. The motorized dome shall employ a modular design with an internal CPU and a customer interface board that provides connections for an external power supply input, four alarm inputs, one relay output and network wiring. On-board memory shall be retained in the housing.
- D. The network dome shall provide network video transmission using either MPEG-4, open platform H.264 or JPEG compression. The dome shall support ONVIF open architecture connectivity to enable third party software recording.
- E. Programmable titling shall be provided for the camera and every preset position, alarm, relay, and sector. Titles shall be enabled or disabled individually or globally. The overall position of the titles and display frame position shall be programmable. The capability to fade titles after a programmable time shall be provided.
- F. There shall be eight tours available with 32 steps per tour. There shall be two auto tours available with 256 pan, tilt and zoom functions per auto tour. Timing shall be dynamic or as is actually programmed with the joystick and push buttons. During the submittal review meeting, coordinate tours with the Architect and Owner.
- G. Pan and tilt functions shall be programmable. Maximum manual pan and tilt speeds shall be programmable. Maximum pan speed shall be 400 degrees/sec and maximum tilt speed shall be 150 degrees/sec. Pan and tilt speeds shall also be scalable to the zoom setting.
- H. The camera shall provide high level, programmable functions. Configuration of the dome shall be done through a web browser. The gain control shall be adjustable. The shutter speed shall be automatic or manual. The camera shall have white balance gain using red and blue scales. Backlight compensation or Wide Dynamic Range shall be programmable. Synchronization shall be internal.

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- I. The basic ceiling mounted version shall be designed to mount into any dropped or hard ceiling having the capacity to support the dome's weight. There shall be an optional mounting kit for ceilings not able to support the dome's weight.
- J. A real time clock and scheduler shall be available on all models. Up to 64 events shall be able to be scheduled for action at a programmed time of day. Events that may be scheduled include a preset, turning a relay on or off, enabling or disabling an alarm, and calling a tour or an auto tour.
- K. 16 individual zoom-scalable programmable privacy masks shall be available for simultaneous display on screen; 80 total shall be available.
- L. Motion detection capability shall be available. There shall be 12 predefined zones for motion detection. Each zone has 3 sensitivity levels. Programmable actions may be associated with each detection zone, including calling another preset, turning a relay on or off, and calling a tour or an auto tour.
- M. The dome shall have a maximum video transmission rate of 30 fps.
- N. Audio input shall be provided.
- O. Coordinate all tour programming preset positions and home position with the Owner.
- P. Cameras shall be Color with a UL listing.
 - 1. Imaging sensor: 1/2.8-inch Type CMOS sensor.
 - 2. Lens: 30X optical.
 - 3. Video compression: H.264, MPEG-4, JPEG.
 - 4. Casing: Metal casing and polycarbonate smoked dome.
 - 5. Resolution: 1080p.
 - 6. Frame Rate: up to 30/25 fps in all resolutions
 - 7. Power: PoE+ (indoor unit only); 18-30 VAC
 - 8. Operating Temperature: -40-131 deg F Outdoor
 - 9. Application: Outdoor/Impact-Resistant; IP66, Indoor Pendant; IP52, Indoor In-Ceiling; IP51
 - 10. Image Settings: WDR, EIS, manual shutter time, compression, color brightness, sharpness, rotation, aspect ratio correction, text and image overlay, privacy mask
- Q. Acceptable Manufacturers
 - 1. Axis

2.7 CEILING CORNER MOUNT IP CAMERA

- A. The latest model available from the camera manufacturer shall be utilized.
- B. The indoor high-security camera shall incorporate a housing, camera, and lens. Its design shall be specifically for use in custodial suites and prison cells. The high-resolution day/night camera shall be available with an integral 2.0 mm wide angle lens.
- C. The camera shall be waterproof and shall fit into a 90° corner. It shall consist of a two part steel assembly, a fixed mounting frame and a removable front plate. The front plate shall be recessed and secured to the fixed frame with security screws. The front plate shall have a window to protect the camera. Once installed, it shall be able to be permanently sealed to the wall to make the housing ligature proof.

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- D. The camera shall support proprietary H.264MP and M-JPEG compression.
- E. The camera shall have an adjustable mount that shall allow it to be tilted up or down for an exact view.
- F. The camera shall be powered by either PoE or 24 VAC.
 - 1. Imaging sensor: 1/2.7" CMOS
 - 2. Lens: 2.0mm
 - 3. IR Coverage: 30'; 3 LED, 940nm
 - 4. Video compression: H.264, MPEG-4,
 - 5. Casing: Vandal-resistant and anti-ligature
 - 6. Resolution: 1440 x 1080
 - 7. Power: PoE or 24VAC
 - 8. Operating Temperature: 14-122 deg F
- G. Acceptable Manufacturers
 - 1. Axis

2.8 VMS NETWORK SWITCHES:

- A. Specifications:
 - 1. 24 or 48 Ethernet 10/100/1000 PoE+ ports with minimum of 1 Gigabit uplink
 - 2. 370-740 W of available PoE power.
 - 3. 4 - Gigabit Ethernet SFP ports for stacking or uplinks
 - 4. Ability to stack units or implemented as a distributed stack at multiple locations and managed as a single-IP entity
 - 5. Multicast routing, IEEE 802.3af Power over Ethernet
 - 6. High resiliency and continuous availability with active load sharing and support for ultra-fast failover recovery
 - 7. Layer 2 security with ACL ports, IEEE 802.1X operation with multiple authentication mechanisms.
 - 8. Have the ability to prioritize converged network traffic to ensure high levels of service for latency-sensitive applications
- B. Acceptable Manufacturer
 - 1. Cisco
 - 2. HP
 - 3. Approved equal

2.9 LENSES

- A. This contractor shall include in their estimate lenses adequate for the functional criteria described and shall change lenses without additional cost to the Owner such that all areas are appropriately covered under actual test conditions. Cameras monitoring specific doors shall have lenses adequate to identify the individual.
- B. Cameras monitoring outdoor activity, long corridors, and large indoor areas shall have lenses adequate to identify the nature of the activity in the area.

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- C. During the final testing of the system, the Owner shall sign off on each camera view for proper angling and coverage. This signed list shall be submitted before substantial completion.

2.10 CAMERA HOUSINGS AND SUPPORTS

- A. Recessed ceiling or wall mounted housing shall be a high security camera enclosure rated for interior or exterior use with a built in heater. For exterior wall mounted applications provide appropriate mounting arms and brackets.
- B. Provide all accessories to accomplish the specified mount according to the camera schedule. The mounts shall all have internal protective passage for cables. All cameras and domes shall be mounted with required housings for complete installation.

2.11 POWER SUPPLIES

- A. INTERIOR 24 VAC POWER SUPPLY
 1. Input Voltage: 120VAC, 60 Hz
 2. Output Voltage: 28VAC, Fusing: 10A
 3. Input Connector: Line Cord
 4. Output Connector: Screw type barrier strip
 5. Rating: NEMA1
 6. 32 class 2 rated PTC protected power limited outputs
- B. Acceptable Manufacturer:
 1. Altronix
 2. Approved Equal

END OF SECTION 285200

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SECTION 285260 – VIDEO MANAGEMENT SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this section.

1.2 WORK IN THIS SECTION:

- A. A Video Management System (VMS) shall be provided to support all of the cameras in the facility.
- B. Provide system from Salient to stay consistent with Owner standard.
- C. This section includes the requirements and operational characteristics for a Video Management System, which is an integral part of the Security Control System. Video Management Systems included are:
 - 1. Video Management System Servers
 - 2. Video Storage equipment.
 - 3. Client Computers.
- D. Provide all labor, equipment, materials, licenses, and supervision to install, program, calibrate, adjust, document, and test the total system as required herein and on the drawings.
- E. Provide documentation, as part of the submittal, indicating that the individuals installing the Video Management system have been trained and have installed this product prior to this project.

1.3 SYSTEM DESCRIPTION

- A. Provide a Video Management System with the following system features and software requirements to allow for seamless control and future flexibility:
 - 1. Integration of the VMS with the VGUI system to allow VGUI operators to provide manual camera call-up, automatic camera call-up (from active intercom call, duress alarm, etc.) and display of live video in a designated area on the VGUI monitors.
 - 2. Digital video recording of all the cameras in the VMS system.
 - 3. Configuration, viewing of recorded images, and ability to record incidents to DVD-R discs.
 - 4. Video recording should be in a non-proprietary format such that no special program is required to view them.
 - 5. Provision of client computers loaded with the VMS client software to perform the following operations;
 - a. Live display of cameras
 - b. Live display of camera sequences
 - c. Control of PTZ cameras
 - d. Playback of archived video
 - e. Retrieval of archived video
 - f. Instant replay of live video
 - g. Use of procedures
 - h. Configuration of system settings

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- i. Execution of system macros
- B. VGUI station shall have ability to call up camera views to a secondary monitor attached to the VGUI station. Camera selection for each VGUI shall be limited to that VGUI's control responsibilities (i.e. – the Pod VGUI station shall only be able to select cameras that are in its area of control).
- C. The VMS software run on standard off-the-shelf computer server and communicating over Ethernet network using the TCP/IP network protocol. The proposed solution shall not require proprietary computer hardware. The proposed solution shall be based on Windows™ Server Operating System.
- D. The VMS system shall be based on the latest in software programming technology and shall be based on Microsoft .NET frame work. The software shall be the latest and most current platform offered by the manufacturer.
- E. The VMS system shall support both analog and IP cameras. Support of analog cameras shall be done using Camera Encoder Video Servers and shall not require the installation of video capture cards.
 - 1. The VMS shall support both NTSC and PAL video formats.
 - 2. The VMS shall support video both from analog and IP fixed color/B&W cameras, PTZ/Dome cameras, infrared cameras, X-Ray cameras, low light/IR cameras, and any other camera that provides a composite NTSC/PAL 1v p-p video signal.
- F. The VMS shall support the H.264, JPEG, M-JPEG, MPEG-4, MPEG-2 video format simultaneously.
- G. The VMS shall sustain full operation using VGA, HD and Megapixel video resolutions.
 - 1. The VMS shall be able to support all cameras at the maximum frame rate and the maximum resolution while maintaining less than 80% load on the Server.
- H. The VMS in addition to Video shall provide full Audio monitoring and recording functionality.
- I. The VMS shall allow for 2-way audio communication using the audio interface
 - 1. The VMS shall provide the ability to communicate back to an audio enabled Encoder, Decoder or IP camera and provide an IP based Intercom.
- J. The VMS Audio function shall be available as independent sources and/or synchronized with video.
- K. The VMS shall allow the use of audio inputs for Audio recording of telephone lines, microphones, radio systems or any other analog audio interface.
 - 1. The VMS shall allow for audio search by date, time and alarm event with or without association to video.
 - 2. The VMS Media Archive Server, for video and audio, shall be sized to support and manage all camera connection from IP cameras or video Encoders each at 30fps.
- L. The VMS shall be based on the TCP/IP communication protocol between all IP cameras, Encoders, Decoders, Video Management Management Software and Media Archive Servers.
- M. The VMS storage system shall be based on advanced recording methods and shall not rely on the Windows Operating System to manage the storage.
- N. The VMS shall provide the coactivity to an external storage system. The VMS storage option as a minimum shall provide RAID-5 redundancy. All storage redundancy and mirroring

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capabilities shall be done using hardware interface and shall not rely on the Windows Operating System to perform these functions.

- O. The VMS shall be based on high quality H.264 and/or MPEG-4 IP cameras.
- P. The network based video recorder server (Media Archive Server) shall as a minimum provide multi-video compression support and shall simultaneously record video from H.264, MPEG-2, MPEG-4 video and JPEG and M-JPEG image compression algorithm standards. The VMS shall allow for specific camera to be set at the most optimized recording technique, H.264, MPEG-2, MPEG-4, J-PEG or M-JPEG, and should be available for live monitoring and recording signals. The system shall be flexible and as a minimum, the compression scheme shall be able to run in one of several bandwidth selections.
- Q. The system shall allow the recording, live monitoring, playback of archived video audio, and data simultaneously. The VMS shall allow the user to view live video at 30 fps while recording at a lower frame rate for more efficient video storage.
- R. The VMS client application shall support two flat panel monitors to be connected to a single computer.
- S. Each monitor shall have independent controls and shall support multi views up to 16 real time camera views.
- T. The VMS client application shall allow each user the ability to view 32 cameras on a single PC, all at 30fps.
 - 1. The system shall maintain the capability to add additional flat panel monitors for other applications.
- U. The VMS shall provide a reporting utility for tracking, including, but not limited to, the following options. Video and images shall be stored with reports for documenting events.
 - 1. Alarms
 - 2. Incidents
 - 3. Operator logs
 - 4. Service requests
- V. The IP Based VMS shall provide a file export tool for export of single frames of video in J-PEG and BMP file formats and for export of motion video files in AVI file format for transport and playback on computers utilizing a Windows environment.
- W. The VMS database and video storage shall be based on SQL Server. The VMS operating system shall be Microsoft Windows Server. The IP Based VMS shall allow for installation of Anti-Virus and network security Software. This shall be on a separate network.
- X. The VMS shall be initially configured by the Security Control System Contractor, and coordinated with the Owner, to configure system parameters according to the operation of the facility, taking the needs of all cameras (down to an individual basis) into consideration.
- Y. Acceptable Manufacturers:
 - 1. Salient

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

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- A. Video Management System (VMS) Central Directory Server
1. General: The Directory Server shall store a centralized system database and manage the VMS and user security privileges.
 2. VMS Server Software:
 - a. The VMS software shall consist of an MS-SQL 2008 or better based Main Directory Database Server, Media Archive Server (audio and video), Digital Virtual Matrix, Incident Reports, Alarm Management, Network Management System and Watchdog modules.
 - b. The VMS SQL based Database Server shall offer the capability to be installed on multiple servers to enable distributed architecture on the LAN or WAN.
 - c. The VMS Database Servers shall not limit the number of Media Archive Servers which can be networked together to form a distributed video management and recording system.
 - d. The VMS Database Server shall maintain a catalog of settings for all the client, servers, encoders, decoders and IP cameras in the system.
 - e. The VMS Media Archive Server shall offer the capability to be installed multiple servers software on multiple Computer Servers to enable distributed archiving architecture on the LAN or WAN.
 - f. The VMS shall record all video from all IP cameras, in the native video format of each (e.g. Mpeg-4, MPEG-2 or M-Jpeg video compressions).
 - g. The VMS shall record all video in real time simultaneously at bandwidth ranging from 8 Kb/sec to 4 Mb/sec, frame rates ranging from 1fps to 30fps NTSC/25PAL and resolution ranging from CIF (352X240 NTSC) to 1080p HD (1920x1080 NTSC).
 - h. The VMS shall be able to set each camera frame rate, bit rate and resolution independently from other cameras in the system, and altering these settings shall not affect the recording and display settings of other cameras.
 - i. The VMS shall require no proprietary hardware for video and audio recording servers.
 - j. The VMS shall not utilize any hardware or software multiplexer or time-division technology for video or audio recording and monitoring.
 - k. The VMS shall provide a Redundant recording module for system redundancy.
 - l. The VMS shall support a built-in Digital Video Matrix Switcher
 - m. The VMS shall support an Internet Video Broadcast server (IVB).
 - n. The VMS shall support video motion detection module.
 - o. The VMS shall support a built-in Watchdog module.
 - p. The VMS shall provide a full interconnectivity between analog matrix operations and IP video to analog and digital outputs. The VMS shall have the capacity for unlimited analog video inputs and outputs.
 - q. The VMS shall have the capability to program each IP viewing station to view and control selected cameras only.
 - r. The VMS shall provide a Windows-based GUI (Graphical User Interface). The VMS shall provide operation on multiple VGA monitors connected to a single PC using standard hardware and software.
 - s. The VMS shall be based on a true open architecture that allow for use of industry standard PC and storage hardware that shall not limit the storage capacity and shall allow for gradual upgrades of recording capacity. The VMS shall digitally sign recorded video using 2048-bit RSA public/private key encryption. The VMS shall allow for changing the encryption key.

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- t. The VMS Shall support management and control over unlimited satellite sites.
 - u. The VMS shall provide alarm dry contact interfaces to allow for any alarm input initiating any action in the VMS system. The VMS shall provide a serial interface for alarm input to allow for any alarm input initiating any action in the VMS system.
 - v. The VMS Shall support full duplex audio communication and transmission signals over the IP Digital Transmission Network.
 - w. The VMS shall provide alarm management module.
3. VMS Central Directory Server Configuration (minimum requirements):
- a. Dual Processor (x2) Intel Xeon ES-2660, 2.20GHz, 20M Cache, 8.0GT/s QPI, Turbo, 8C, 95W, Max Mem 1600MHz
 - b. Memory: 32GB: Two (2) 16GB RDIMM, 1600MT/s Low Volt, Dual Rank, x4 Data Width
 - c. Operating System: Windows Server 2022
 - d. Hard Drive Configuration: RAID 1, with discrete RAID Adapter with Battery Backup and 512MB NV Cache.
 - e. Hard Drives: Two (2) 250GB Solid State, SAS, SLC 6Gbps, 2.5", hot-pluggable
 - f. Power Supply: Redundant Power Supplies with separate power cables to connect to different circuits.
 - g. Network Adapter: On-Board Dual Port Gigabit Network Adapter
 - h. DVD 8X Optical Drive
 - i. 5 Years of Manufacturer Hardware Warranty with Critical Support Services (24x7x365 with 2-hour onsite response)
 - j. Approved manufacturers: Dell PowerEdge series, HP
- B. Video Management System (VMS) Archiver Server
- 1. General: The Archiver Server shall operate the recording and playback of video, audio and meta-data. Provide required number of archiver servers to meet system requirements.
 - 2. VMS Archiver Server Configuration (minimum requirements):
 - a. Dual Processor (x2) Intel Xeon ES-2660 2.20GHz, 20M Cache, 8.0GT/s QPI, Turbo, 8C, 95W, Max Mem 1600MHz
 - b. Memory: 32GB: Two (2) 16GB RDIMM, 1600MT/s Low Volt, Dual Rank, x4 Data Width
 - c. Operating System: Windows Server 2022
 - d. Hard Drive Configuration: RAID 1, with discrete RAID Adapter with Battery Backup and 512MB NV Cache.
 - e. Hard Drives: Two (2) 250GB Solid State, SAS, SLC 6Gbps, 2.5", hot-pluggable
 - f. Power Supply: Redundant Power Supplies with separate power cables to connect to different circuits.
 - g. Network Adapter: On-Board Dual Port Gigabit Network Adapter
 - h. DVD 8X Optical Drive
 - i. 5 Years of Manufacturer Hardware Warranty with Critical Support Services (24x7x365 with 2-hour onsite response)
 - j. Approved manufacturers: Dell PowerEdge series, HP
- C. Video Storage Equipment
- 1. General: Direct attached disk storage enclosures shall be provided supporting multiple SAS drives for the storage of video files. The storage enclosures shall be attached to the VMS server(s) and shall be configured in a RAID 5 configuration. Sufficient disk

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storage shall be provided to provide video storage for all the cameras in the VMS system with the following configuration: All cameras being recorded continuously 24/7 at 10 images per second per camera, recording at native resolution, with H.264 and/or MPEG-4 compression, assuming an activity level of 35% across all cameras and providing for a minimum of 30 days of storage. The system automatically replaces the oldest video stored when the system storage capacity is reached.

2. Provide multiple attached disk storage enclosures (as required for recording requirements) which meet the following specifications;
 - a. PCI SAS RAID adapter for the VMS Archiver Server, for RAID 5
 - b. Hot-pluggable SAS Drives (size and type based on calculated storage required)
 - c. Storage Enclosure shall be configured for N+1 drives to ensure there is a hot, spare drive available
 - d. Hard drive capacity: Up to twelve (12) hot-pluggable SAS Hard Disk Drives (HDDs) at 7200, 10K, and 15K rpm and SAS solid state
 - e. Two (2) enclosure management modules
 - f. Power Supply: Redundant Power Supplies with separate power cables to connect to different circuits.
 - g. Approved manufacturer: Dell™ PowerVault™ MD1200 series with sufficient storage to meet the requirements as specified above.

D. Client Computers

1. General: VMS Client Computers shall be provided at locations as shown on the plans. Designated client computers shall provide the administrative user interface for the system, enabling the definition and configuration of various system aspects.
2. VMS Client Software
 - a. The VMS client shall consist of Administrator Tool application, a Monitoring application, an Archive Player application, a Web Monitoring access, a Web Archive Player access and a Mobile Monitor application.
 - b. The VMS client shall perform the following applications simultaneously without interfering with any of the Archive Server operations (Recording, Alarms, etc.): live display of cameras, live display of camera sequences, control of PTZ cameras, playback of archived video, retrieval of archived video, instant replay of live video, use of procedures (Macros), configuration of system settings, execution of system macros.
 - c. The VMS client applications shall support any form of IP network connectivity, including: LAN, WAN, VPN, Internet, and Wireless (WiFi and Cellular) technologies.
 - d. The VMS client applications shall support IP Multicast (UDP) and Unicast (TCP or UDP) video streaming. The VMS client applications shall automatically adapt to the network topology and use the best available method to receive streaming video.
 - e. The VMS client applications shall provide an authentication mechanism, which verifies the validity of the user.
 - f. The Client Monitor application shall allow for live monitoring of video and audio.
 - g. The VMS Monitor application shall allow operators to view an instant replay of any camera.
 - h. The VMS Monitor application shall allow operators to add bookmarks or to switch their instant replay view into the Archive Player application, for advanced operations, by clicking on a single button in the Instant Replay tab.

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- i. The VMS Monitor application shall provide management and control over the system using a standard PC mouse, keyboard and VMS keyboard.
- j. The VMS Monitor application shall display all cameras attached to the system regardless of their physical location on the network.
- k. The VMS Monitor application shall display all camera sequences created in the system. The VMS Monitor application shall allow for unlimited cameras sequences, which can be run independently of each other on either digital VGA monitor tiles or analog VMS monitors.
- l. The VMS Monitor application shall allow operators to control (Pause/Play, skip forwards, skip backwards) Camera Sequences, without affecting other operators' ability to view and control the same sequence.
- m. The VMS Monitor application shall display all cameras, sequences and analog monitors in a logical tree. The VMS Monitor application operator shall be able to drag and drop a camera from a tree of available cameras into any video tile or an analog monitor icon for live viewing. The VMS Monitor application operator shall be able to drag and drop a camera sequence from a tree of cameras into any video tile or an analog monitor icon for live viewing.
- n. The VMS Monitor application shall support the procedure functionality, where procedures can be triggered to appear during a certain event & can be used to provide detail written or verbal instructions to the operator as to the actions to be taken.
- o. The VMS Monitor application shall support digital zoom on a fixed camera's live video streams. The VMS Monitor application shall support digital zoom on a PTZ camera's live video streams.
- p. Each workstation running the IP Based VMS client application shall be able to use a VMS keyboard that can control the entire set of cameras throughout the system, even if the system consists of motorized cameras produced by different manufacturers.
- q. The VMS shall support full control for PTZ (Pan Tilt and Zoom) cameras.
- 3. Client Workstation with keyboard & mouse shall consist of an Intel Core i5-4570 quad core, 3.2GHz turbo processor or better Computer with 512K cache, 8GB 1600MHz DD3 Memory, 250GB hard drive, 2 USB ports, network card for Ethernet operation, CD-ROM drive, sound card, video accelerator, running Windows 10 Pro. Provide UPS power for all workstations.
- 4. Approved manufacturers:
 - a. Dell
 - b. HP
- 5. Approved client software manufacturer:
 - a. Salient
- E. Accessories:
 - 1. Provide one or more KVM switches sized for the number of Video Management System servers in the system. Approved KVM switches: Tripp Lite. Provide KVM Switch cable kits as required.
 - 2. Provide 1U Rack Mount LCD monitor keyboard drawer with 19" TFT, keyboard and touch pad equal to Acnodes Model KD8190 or approved equal.
 - 3. Provide multiple 24-port 10/100/1000 BASE-TX Fast Ethernet managed stackable rack-mountable switches with 2 mini GBIC ports.

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- F. Spares:
 - 1. Refer to Section 285000.

PART 3 - EXECUTION

3.1 QUALITY ASSURANCE

- A. The Security Control System Contractor shall provide a block-switching table that incorporates all requirements of the intercom, video call up and alarming specified in all other sections of this division. The Owner shall maintain the right to request modifications at any time during the warranty period at no charge.

3.2 EXAMINATION

- A. Verify that surfaces and areas are ready to receive work. Verify field measurements are as shown on Drawings and as instructed by manufacturer. Verify that required utilities are available, in proper location, and ready for use.

3.3 INSTALLATION

- A. Field testing and inspection will be performed under the provisions of Section 285000.
- B. Replace equipment, components, and wiring as required, achieving a fully functional system.

3.4 COMMISSIONING

- A. Train Owner's maintenance personnel in the procedures and schedules involved in operating, programming, troubleshooting, servicing, and preventative maintenance of the system. Schedule training with Owner through the Architect, with at least seven days notice.

END OF SECTION 285260

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SECTION 285300 – ACCESS CONTROL SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this section.

1.2 SUMMARY

- A. Provide and install as shown on the Drawings and herein specified a complete and operable Access Control System. Readers shall consist of proximity readers, proximity reader/keypads, and other access control system devices. Upon correctly entering a personal ID code or presenting a proximity card / keyfob the system shall grant access to a controlled device or resource
- B. Provide system from AMAG to stay consistent with Owner standard.
- C. Coordinate with the owner all the card, keyfob or other credential types being used by the owner and provide a system that will work with those existing credentials.
- D. The Access Control System shall be installed in accordance with all applicable NEC, and local building codes. All equipment shall be UL labeled. All equipment shall be compatible
- E. The Access Control System shall interface to the Fire Alarm System as required to meet all required Fire and Life Safety Codes
- F. The system shall include, but not be limited to, the following
 1. Proximity card readers
 2. Proximity card & keypad combo readers
 3. Control Processors
 4. Alarm monitoring modules
 5. Output relay modules
 6. Access control proximity cards & key fobs
 7. PC running the Card Access System's Software
 8. All required licenses to function completely and expand 25%.
 9. I.D. Photo Access Cards with identification images and logos
 10. Support Biometric readers
 11. Support Magnetic stripe card readers
 12. Support keypads & pin pads
- G. Provide archive/purge and backup utilities for database maintenance.
- H. The Access Control System's database shall be fully integrated with the database of the Security Management Server (SMS), allowing the token user's Name, not ID code, to be logged by the SMS upon any use of a token reader. The system shall log all access control events, including access granted, access denied, and duress codes used. All access control events shall be associated with the token user's Name. Provide secure lock operation and maintain audit trail, even when the server or the network is unavailable.

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- I. The Access Control System's database shall be capable of a minimum of 5,000 user accounts. The Access Control System shall be capable of supporting 100 client licenses. Access Control system database shall be Microsoft SQL 2022 or better.
 - J. The Access Control System shall be a robust, user-friendly, easily expandable solution. Users shall be added, modified, and deactivated using a Windows-based GUI interface. Each user shall be given customized access rights to controlled devices and other resources based on the time of day, day of the week, and restricted dates. In addition, users must be able to be assigned to customized user groups, which system administrators shall be able to create in order to streamline the access management process and tailor it to their own needs.
 - K. The Access Control System shall integrate seamlessly with the Security Control System to visually alert operators when a door has been accessed via the reader system and shall allow VGUI operators to isolate (disable) individual readers to prevent access. The SMS shall be able to log requests at doors with an isolated reader. Users shall be capable of entering Duress Codes at proximity reader/keypads, which shall activate a duress alarm at that location on one or more VGUI's. The same level of integration shall also be seen on the SMS, which shall record the user's Name and time when a resource is accessed and shall include a full range of reporting features. Login to the Access Control software shall be password protected and access shall be logged to the SMS.
 - L. The access system shall not directly open any doors. It shall make door open requests of the PLC System. The PLC System shall verify interlocking of the requested door and status of the reader prior to any unlocking.
 - M. The system shall also have a fully integrated, Windows-based help system. The system shall also have context sensitive help.
 - N. The system shall have a lockout feature after an invalid access code has been entered four times on a keypad.
 - O. The system shall be programmable with a master code so that access can be granted through a card reader/keypad combo device with only the master keypad code and no proximity card.
 - P. Provide hardware and software as a single integrated application for all of the following:
 - 1. Online locks that are programmed and controlled via a central computer which communicates via the network to controllers which are then wired to the individual door locations.
 - 2. Offline locks which may become disconnected from a central computer system, but are managed and programmed by the same software application.
- 1.3 CARD ACCESS CLIENT VIEWING STATION COMPUTER:
- A. Central Equipment: Provide a Client station with Card Enrollment equipment as indicated on the drawings. All central equipment power shall be provided from emergency circuits. Additional UPS or Battery Backup power shall be provided for all central equipment to provide error free operation. Central equipment shall include but not be limited to the following:
 - 1. Intelligent Controller: Supports up minimum of 8 readers. Firmware for 10,000 cardholder records and 1,000 transactions. Shall support both proximity readers and keypads simultaneously for each door. Systems shall be capable of optionally supporting LAN or WAN communications using TCP/IP.

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2. Access Control Software shall operate on Windows 11 or better. Software shall include Administration, Event Monitoring, Status Windows, and multiple application windows open simultaneously, Software shall also include the following.

1.4 SOFTWARE FEATURES

- A. User Configuration Functions: A user shall include any individual that uses the access control system to access resources, such as a door, software application, or VGUI. A user shall also include an administrator who is using the access client software to add users and set permissions and rules. User configuration functions shall include the following:
 1. Creating a New User
 - a. Provide a User Configuration screen that shall allow the operator to create a new user or display information about current users. The information fields displayed shall include the following; Last Name, First Name, Middle Name and ID Number. The ID Number shall be any combination of letters and numbers up to a maximum of 50 characters
 - b. Optionally, a User Type shall be capable of being selected: Types shall include (None), Staff, and Visitor. A user type of Inmate or Staff must be selected when using the work release or time and attendance tracking features respectively
 - c. Any custom user information shall be capable of being entered into the Additional Information tab
 - d. An image shall be capable of being associated with a user and stored in the SMS database for retrieval from the client software or VGUI(s)
 2. Modifying a User (Searching)
 - a. Provide a means to modify information about existing users
 - b. Provide a User Search dialog box that, by default, displays all active users in the database. The User Configuration screen for each user shall be displayed upon the selection of a user in the database
 - c. Provide a means to facilitate a more refined search. The operator shall be capable of selecting a field (i.e. – Last Name, First Name, ID Number, token, etc.) to search on in a “Search” list and typing the desired text in a “For” box. The operator shall also be capable of searching for deactivated accounts by means of a checkbox selection
 3. Acquiring an Image for a User
 - a. Provide a means to capture an image and associate it with an individual user in the database
 - b. Provide an Image Acquire screen that shall allow an operator to capture an image via an image capture device (i.e. – USB camera). Provide a drop-down list of available image capture devices
 - c. Provide a preview window that displays a live video stream. Depending upon the options available for the selected image capture device, provide Format, Source, Compression, and Display buttons to allow the operator to fine-tune the video stream
 - d. Provide an Image Capture button for the operator to select once the user is positioned properly in the preview window. Once selected, the image shall appear in a separate user image window. Provide a means to assign the captured image to the user
 4. Importing an Image for a User

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- a. Provide a means to import an image and associate it with an individual user in the database
- b. Provide an Import Image screen that shall allow an operator to import an existing image. Provide a window for the operator to browse to an existing image and open the image once it is found
- c. Provide an outlined area (or box) showing the size of the user image window. If the imported image is larger than the user image window, the operator shall be able to relocate the image box by holding down the left mouse button and dragging the box to the desired location within the image. Provide a means to assign the imported image to the user
- 5. Assigning Permissions to a User
 - a. Provide a means to allow users access to system resources
 - b. Provide an Assign Permissions tab within the User Configuration screen. This screen shall show a list of all system resources. Each resource shall include a checkbox to allow access to that particular resource. Provide a "filter" box with drop down menu to allow the operator to select and display a particular type of resource. Resource types shall include, but not be limited to, the following; Doors, VGUI's, Access Control System Client software, SMS client, etc
 - c. Provide Check All and Uncheck All buttons for the operator to select to simplify the assignment of permissions
- 6. Assigning a User to User Groups
 - a. Provide a means to allow users to be assigned to User Groups. A User Group shall be defined as a specific group of users who share the same permissions and rules. When a user is assigned to a group, they shall receive the same permissions and rules that the group has, in addition to their own individual permissions and rules. Users shall be capable of belonging to more than one user group
 - b. Provide an Assign Groups tab within the User Configuration screen. This screen shall show a list of all user groups in the system. Each group shall include a checkbox to assign the user to that particular group
- 7. Assigning Rules to a User
 - a. Provide a means to assign rules to a user. Assigning rules to a user shall allow the user's permissions to be restricted to specific days of the week, as well as specific times of the day. Provide a means to have a user's access to activate or expire on a specific day or prevent them from using permissions on restricted dates
 - b. Provide an Assign Rules tab within the User Configuration screen. Provide an 'Allow access only on selected days of the week' checkbox for users that are allowed access only on specific day(s). Provide checkboxes for each day of the week for the operator to select for days they want the user to have access on
 - c. Provide an 'Allow access only during time range' checkbox for users that are allowed access only during specific times. Provide time configuration boxes for 'No earlier than' and 'No later than' that include the time in hours, minutes and seconds. Provide indications for "AM" and "PM"
 - d. Provide an 'Unrestricted Access' checkbox to select for users that have no access restrictions based on the time of the day and the day of the week
 - e. Provide an 'Access has activation date' checkbox for users that have permissions that should not begin until a later date. Provide a drop-down calendar tool to set the activation date

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- f. Provide an 'Access has expiration date' checkbox for users that have permissions that should expire on a certain date. Provide a drop-down calendar tool to set the expiration date
 - g. Provide an 'Allow access on restricted dates' checkbox for users that are allowed access on restricted dates
- 8. Assigning Tokens to a User
 - a. Provide a means to assign tokens to a user. Assigning Tokens to a user consists of assigning items such as a PIN code, Duress Code, proximity card number, password, etc. that the Access Control System uses to identify a user
 - b. Provide an Assign Tokens tab within the User Configuration screen. All tokens assigned to a particular user shall be displayed on this tab
 - c. Provide information fields for the following tokens: Proximity Card, Personal Identification Number, Duress Code and User Name and Password
 - d. Provide a Proximity Card field that shall be used to assign a proximity card or keyfob ID number to the user. For this feature, a proximity reader enrollment station may be used. The operator shall activate an Enroll button and swipe a proximity card or keyfob at the enrollment reader. The proximity ID will appear in the field when the card or keyfob is read
 - e. Provide a Personal Identification Number field that shall be used to assign a unique number to a user for use with proximity readers with a keypad option. Upon correct entry of a personal identification number at a keypad, the user shall be granted access to the resource. The personal identification number shall be up to a maximum of 12 digits long, and unique for all users
 - f. Provide a Duress Code field that shall be used to assign a unique number to a user for use with proximity readers with a keypad option. Upon correct entry of a duress code at a keypad, the local and Central Control VGUI(s) shall be notified that a duress alarm exists. The duress code shall be a maximum of 13 digits long
 - g. Provide User Name and Password fields that shall be used to assign a unique user name and corresponding password for the purpose of accessing VGUI's and the access control system client software
 - h. Provide for a replacement card to automatically invalidate the user's previous lost card
- 9. Creating a New User Group
 - a. Provide a means to create User Groups, which shall allow the operator to easily assign the same permissions and rules to many users
 - b. Provide a Group Configuration screen that shall allow the operator to create a new group or display information about current groups. The information fields displayed shall include the following; Group Name
- 10. Modifying a User Group (Searching)
 - a. Provide a means to modify information about existing user groups
 - b. Provide a User Group Search dialog box that, by default, displays all active user groups in the database. The User Group Configuration screen for each user group shall be displayed upon the selection of a user group in the database
 - c. Provide a means to facilitate a more refined search. The operator shall be capable of selecting a field (i.e. – Group Name, Resource Type, Resource Name) to search on in a "Search" list and typing the desired text in a "For" box
- 11. Assigning Permissions to a User Group
 - a. Provide a means to allow user groups access to system resources

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- b. Provide an Assign Permissions tab within the User Group Configuration screen. This screen shall show a list of all system resources. Each resource shall include a checkbox to allow access to that particular resource. Provide a “filter” box with drop down menu to allow the operator to select and display a particular type of resource. Resource types shall include, but not be limited to, the following; Doors, VGUI's, Access Control System Client software, SMS client, etc
 - c. Provide Check All and Uncheck All buttons for the operator to select to simplify the assignment of permissions
 - 12. Assigning Rules to a User Group
 - a. Provide a means to assign rules to user groups. Assigning rules to a user group shall allow the user group's permissions to be restricted to specific days of the week, as well as specific times of the day. Provide a means to have a user group's access to activate or expire on a specific day or prevent the group from using permissions on restricted dates
 - b. Provide an Assign Rules tab within the User Group Configuration screen. Provide an 'Allow access only on selected days of the week' checkbox for user groups that are allowed access only on specific day(s). Provide checkboxes for each day of the week for the operator to select for days they want the user group to have access on
 - c. Provide an 'Allow access only during time range' checkbox for user groups that are allowed access only during specific times. Provide time configuration boxes for 'No earlier than' and 'No later than' that include the time in hours, minutes and seconds. Provide indications for “AM” and “PM”
 - d. Provide an 'Unrestricted Access' checkbox to select for user groups that have no access restrictions based on the time of the day and the day of the week
 - e. Provide an 'Access has activation date' checkbox for user groups that have permissions that should not begin until a later date. Provide a drop-down calendar tool to set the activation date
 - f. Provide an 'Access has expiration date' checkbox for user groups that have permissions that should expire on a certain date. Provide a drop-down calendar tool to set the expiration date
 - g. Provide an 'Allow access on restricted dates' checkbox for user groups that are allowed access on restricted dates
 - 13. Assigning Users to a User Group
 - a. Provide a means to assign users to user groups. When a user is assigned to a user group, they receive the permissions and rules of the user group in addition to their own rules and permissions
 - b. Provide an Assign Users tab within the User Group Configuration screen. Each user in the database shall be displayed. Each user shall include a checkbox to assign the user to that particular group
- B. Administrative Configuration Functions: Provide administrative-level tools to enhance and customize the functionality of the access control system software
 - 1. Adding/Modifying/Deleting User Information Types
 - a. Provide a User Information Type screen that shall allow the administrator to create new, modify existing, or delete existing information fields for users. Information types (i.e. – address, phone number, etc.) shall be defined by the administrator on this screen. The administrator shall be capable of assigning a display order for each information field. A minimum of 1000 administrator-definable user information types shall be available

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- b. Once defined, these fields shall be displayed in the User Configuration screen. Provide an Additional Information tab within the User Configuration screen. All additional information specific to a particular user shall be displayed on this tab
- 2. Adding/Modifying/Deleting Restricted Dates
 - a. Provide a Restricted Dates screen that shall allow the administrator to create new, modify existing, or delete existing restricted dates. Restricted Dates shall be used to control access on Holidays or other user-defined dates. Restricted dates shall be defined by the administrator on this screen. The administrator shall be capable of assigning a name, as well as a date for the restricted date on this screen. A minimum of 1000 administrator-definable restricted dates shall be available
 - b. Once defined, access on restricted dates shall be granted by going to the Assign Rules tab within the User Configuration screen, and checking the 'Allow access on restricted dates' checkbox
- 3. Reporting Features: The access system shall have the following reporting features
 - a. User Profile Report: This report shall provide information in a document format on the user, such as full name, ID Number, and whether the account is activated or deactivated. This report shall also detail what group(s) the user belongs to, as well as what resources the user has permission to access. The rules for the user shall also be listed in the User Profile Report
 - b. Resource Report: This report shall provide information in a document format on a particular resource. This report shall detail the specific resource chosen, as well as what group and user permissions are assigned to the resource
 - c. Audit trail available historically or in real time, including standard reports that include, but not limited to:
 - 1) Invalid access attempts
 - 2) Time and attendance
 - 3) Door reader location
 - 4) Group of readers
 - 5) Individual cardholder
 - 6) Operator console activity
 - 7) History report for an alarm point(s) of state. An alarm point state shall be defined as: Normal, alarm, Trouble, Ajar
 - 8) History report for card state. A card state shall be defined as: Normal, Trace, Not Found, Anti-Pass violation, Time Zone Violation, Site Code violation or Expired card
 - d. Ability to design custom reports
- 4. System Backup/Restore: The access system shall have the following administration features
 - a. Database Backup: This tool shall provide a database management window, which shall allow the database files to be backed up to another directory or external media
 - b. Database Restore: This tool shall provide a database management window, which shall allow the database files to be restored from another directory or external media
 - c. Provide automatic backup procedure daily.
- 5. Badge Designer: The system shall have the following Badge Designer features
 - a. Badge Designer Basics: This tool shall be used to create custom badge templates. A badge template can then be assigned to any number of users in order to print

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custom user badges. The badge designer shall be capable of creating templates for use with badges with similar requirements

- b. Badge Printing: This tool shall be used to allow for edge-to-edge card printing
- 6. Software shall have ability to partition control of the system by user ID.
 - a. Allow multiple administrators with partition control.
 - b. Allow a minimum of four administrators with ability to create security levels per operator.
 - c. The cardholder database must be shareable across partitions.
 - d. Must be able to create cardholders that are only accessible from a single partition.
 - e. Hardware components (locks, readers, controllers, etc.) must be able to be assigned to a particular partition or shared across multiple partitions.
- 7. The system shall automatically adjust the time of the system for Daylight Savings changes.
- 8. The system shall cause an alarm when controllers go off-line.

1.5 SUBMITTALS

- A. Refer to Section 285000 for submittal requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. AMAG

2.2 ACCESS CONTROL SYSTEM (FILE) SERVER / CARD ACCESS CLIENT STATION
COMPUTER

- A. Provide a ACS File Server, Card Enrollment equipment and Client stations as indicated. This file server shall be permanently connected to PLC via Ethernet. File Server and Client Station computers shall include but not be limited to the following:
 - 1. Access Control Software shall operate on Windows 11 or better. Software shall include Administration, Event Monitoring, Status Windows, and support multiple application windows open simultaneously.
 - 2. The PC-based workstations shall consist of an Intel Core i5-4570 quad core, 3.2GHz turbo processor or better, 512K cache, 8GB 1600MHz DD3 Memory, 250GB hard drive, 2 USB ports, network card for Ethernet operation, CD-ROM drive, sound card, video accelerator, running Windows 11 pro. Provide UPS power for all workstations.
 - 3. This spec shall be exceeded as necessary when multiple systems are combined onto one station.
 - 4. Approved Manufacturers:
 - a. HP
 - b. Dell
- B. Provide at Access Control System station a 24" or larger LCD flat panel monitor with 1280 X 1024 resolution unless otherwise noted.
 - 1. Approved Manufacturers – Dell, Samsung, NEC, HP

2.3 MATERIALS

- A. Central Equipment
 - 1. All components used in creating the access control system shall be of the same manufacturer and/or approved by the manufacturer for system compatibility. Used

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products shall not be acceptable. Equipment specified herein indicates the types of equipment and the minimum quality of equipment required. It shall be the SCSC's responsibility to assure the compatibility of all access control equipment, software, programming, cable, mounting methods, etc. that are used in providing a complete, fully-functional system.

2. All central equipment power shall be provided from emergency circuits. Additional UPS or Battery Backup power shall be provided for all central equipment to provide error free operation.
3. Intelligent Controller: Supports up minimum of 8 readers. Firmware for 10,000 cardholder records and 1,000 transactions. Shall support both proximity readers and keypads simultaneously for each door. Systems shall be capable of optionally supporting LAN or WAN communications using TCP/IP.

B. Proximity Reader

1. Coordinate mounting to be 48" AFF or less and to avoid issues with trim or other devices.
2. Dimensions: 3.3" x 4.8" x .95"
3. Power Supply: 5-12 VDC
4. Current Requirements: Average – 50/75mA (12VDC)
5. Operating Temperature: -40° to 150°F (-40° to 65°C)
6. Operating humidity: 5-95% relative humidity, non-condensing
7. Transmit and Excite Frequency: 125kHz and 13.56MHz
8. The proximity reader shall be a HID Corp. model Signo 40 or approved equal
9. The proximity reader shall be a HID Corp. model Signo 20 or approved equal when mounted to Mullions or other narrow locations.

C. Proximity Reader/Keypad

1. Dimensions: 3.3" x 4.8" x .95"
2. Power Supply: 5-12 VDC
3. Current Requirements: Average – 50/75mA (12VDC)
4. Operating Temperature: -40° to 150°F (-40° to 65°C)
5. Operating humidity: 5-95% relative humidity, non-condensing
6. Transmit and Excite Frequency: 125kHz and 13.56MHz
7. The unit shall include an integrated weatherized keypad.
8. The proximity reader/keypad shall be a HID Corp. model Signo 40K or approved equal

PART 3 - EXECUTION

3.1 INSPECTION:

- A. Check location, "roughing in", and field dimensions prior to beginning work.
- B. Do not begin installation until all unsatisfactory conditions have been corrected.
- C. Verify field measurements are as shown on Drawings and as instructed by manufacturer.
- D. Verify that required utilities are available, in proper location, and ready for use.

3.2 INSTALLATION/APPLICATION OF ALL SECURITY PRODUCTS:

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- A. Field testing and inspection will be performed under the provisions of Section 285000.
- B. Replace equipment, components, & wiring as required to achieve a fully functional system

END OF SECTION 285300

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SECTION 285400 – DURESS - MISC SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this section.

1.2 SUMMARY

- A. This section includes the requirements and operational characteristics for duress and other miscellaneous systems, which are an integral part of the Security Control System.
- B. Provide all labor, equipment, materials, and supervision to install, program, calibrate, adjust, document, and test the total system as required herein and on the Drawings.

1.3 SYSTEM DESCRIPTION

- A. Duress: Provide duress pushbutton stations as indicated on the Drawings. Each duress location shall annunciate separately at the VGUI control station in control and Central Control. Duress buttons at VGUI control stations shall lock down the VGUI controls when that duress is activated.
- B. Door Release Pushbuttons (PB): Provide pushbutton stations as indicated on the Drawings. Each location shall be an input to the PLC for verification and a request to unlock the door. PLC makes decision to open door or not. These buttons are not hardwired to the lock.
- C. Request-to-Exit Devices (REX): Request-to-Exit devices are provided by Div 8 on all controlled Div 8 doors. SCSC shall coordinate and integrate with REX devices to shunt door alarm when door is exited. The only time a REX shall be programmed to unlock a door is if the door lacks any free egress hardware.

1.4 SYSTEM FEATURES AND SOFTWARE REQUIREMENTS

- A. Duress Alarms
 - 1. Duress pushbutton stations shall be located in specific areas of the facility for the officers to press. Input and output signals from/to these stations shall be connected to the input and output modules of the PLC System.
 - 2. All duress alarms shall be annunciated on the VGUI control station. The owner shall have the option of duress alarms annunciating on all VGUI control stations at no additional cost.
 - 3. Duress stations are normally hidden on the VGUI control station(s). They shall be displayed during an alarm condition only.
 - 4. Upon activation of a duress alarm, the audible alarm shall continually annunciate "DURESS" until the VGUI control station is SILENCED. The Site Plan shall flash in red the area in which the duress occurred to allow quick identification for the operator to select that screen. The audio output from the nearest intercom station shall automatically be broadcast through the VGUI control station speakers. The local VMS camera video shall be displayed on the video call-up monitor in Central Control.
 - 5. When the area of the alarm is shown full screen, the duress icon shall flash in red at a rate of one time per second at the location of the active duress station. Multiple duress stations will be shown individually, but shall only require one silent activation. When

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duress pushbutton stations with illuminated mushroom head pushbuttons are used, the lamp (activated by a PLC output) in the station will flash at a rate of one time per second once activated. Deactivating the duress at the station will not cancel the alarm at the VGUI control station. The duress pushbutton station lamp will become solid once the VGUI control station has SILENCED the alarm to alert the officer in duress that the duress alarm has been recognized.

6. When the local VGUI control station presses RESET, the icon shall become solid red. The duress situation will only be canceled once the remote station has been deactivated and the VGUI control station has RESET the alarm condition. Multiple duress stations must be individually RESET.
7. All duress alarms originating from duress pushbutton stations shall only be able to be reset at the physical duress pushbutton station location, requiring direct intervention of the staff. The VGUI control station shall only be able to silence the alarm annunciation.

B. Miscellaneous Systems

1. Door Release Pushbutton (PB):
 - a. Activation of an exit pushbutton station shall request that the associated door be opened via the PLC System.
 - b. The pushbutton shall not be wired directly to the associated door's electrically powered lock, but to an input point of the PLC System. Activation of the pushbutton shall take into account all interlocking with other doors and shall not create a 'Breached Door' alarm.
2. Request-to-Exit (REX) devices: Shall provide an input signal to the PLC system to:
 - a. Shunt door alarms when exiting the door via free egress hardware.
 - b. Unlock door and shunt alarm for doors without free egress hardware.

PART 2 - PRODUCTS

2.1 Duress Pushbutton Station, Wall-mounted Mushroom Head

- A. Provide an Allen-Bradley 800-T series, illuminated, mushroom head, latching pushbutton mounted to a single-gang faceplate of 12-gauge stainless steel for all wall-mount applications. The text "DURESS" shall be laser-engraved on the faceplate.
- B. Approved equal manufacturer: General Electric.

2.2 Duress Pushbutton Station, Under-Counter

- A. The unit shall include double-pole, double-throw contacts.
- B. The unit shall be supplied with a lock-mounted switch and one key.
- C. The unit shall be designed for silent operation and housed in a stainless steel housing.
- D. For under-counter duress pushbutton stations, provide a single gang box mounted at 18" AFF with 3/8" center hole coverplate and allow 6' of flexible connection to underside of desk. Use cable tie base fasteners screwed to the walls and underside of the counter or desk. Coordinate exact placement at desks and counters with Owner.
- E. Approved Manufacturer:
 1. Amseco Husk 20

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2. Honeywell 269R
3. Approved equal.

2.3 Door Release Pushbutton, Wall (PB):

- A. The switch shall be a momentary, pushbutton, dry contact type that is moisture and damage proof. The contacts shall be rated at three amperes, 300 watts AC with a non-inductive load. It shall be a single pole, single throw momentary action switch, attached to the faceplate from the rear so that it cannot be removed when installed.
- B. The pushbutton shall be captive within the faceplate. It shall be constructed so that it does not provide a permanent closure or call-in indication when operated. The switch shall be mounted on a single-gang faceplate of 12-gauge stainless steel. The text "DOOR RELEASE" shall be laser-engraved on the faceplate.
- C. Approved Manufacturer:
 1. Harding
 2. Southern Folger
 3. Quam
 4. Approved equal

2.4 Door Release Pushbutton, Under-Counter (PB):

- A. The unit shall include double-pole, double-throw contacts.
- B. The unit shall both look and function different from the under counter duress push button.
- C. For under-counter duress pushbutton stations, provide a single gang box mounted at 18" AFF with 3/8" center hole coverplate and allow 6' of flexible connection to underside of desk. Use cable tie base fasteners screwed to the walls and underside of the counter or desk. Coordinate exact placement at desks and counters with Owner.
- D. Approved Manufacturer:
 1. USP HUB2SA
 2. Approved equal.

END OF SECTION 285400

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SECTION 285500 – AUXILIARY CONTROL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this section.

1.2 SUMMARY

- A. Auxiliary control systems shall include remote control of lighting and water control.
- B. Division 22 contractor to provide solenoid valves to interface with the security control system to allow all water to be shut off at each housing unit. SCSC is responsible for conduit and cabling to these solenoid valves and the dry contact outputs to interface with the valves. Provide required interface to shutoff all water at each housing unit (as a group), via the security control VGUI(s).
- C. Division 26 contractor shall provide relay enclosures and relays for all lighting control interfaces. SCSC is responsible for conduit and cabling to these panels and the dry contact outputs to interface with the relays. Coordinate all requirements with Division 26 contractor during the submittal coordination meeting as described in Section 285000. All lighting switch legs shall be wired by the Division 26 contractor.
- D. The lighting control system shall provide for remote switching of lighting circuits. Lighting control shall be implemented using electro-mechanical relays controlled through PLC output modules.
- E. Upon loss of power to the auxiliary system or failure of the PLC input and output modules, the system shall change state to the safest condition for the facility staff.
1. Lighting relays shall fail closed to allow lighting to be on, if the lighting circuit is powered.
- F. Configure the system to automatically turn on lights, which are controlled, in an area from which a duress alarm has been received.
- G. Configure the system to automatically turn on all controlled lights when an emergency evacuation has been initiated.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Auxiliary Control Relays
1. Provide relays to switch the auxiliary circuits as scheduled. Provide one relay per scheduled device.
 2. Manufacturers
 - a. Omron G2R DPDT series relays with din rail terminal base
 - b. Finder
 - c. Idec
 - d. Phoenix
 - e. Approved equal.

PART 3 - EXECUTION

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3.1 EXAMINATION

- A. Verify that all areas are ready to receive work.
- B. Verify required utilities are available, in proper location and ready for use.

3.2 INSTALLATION

- A. Field testing and inspection shall be performed.
- B. Replace equipment, components and wiring as required to achieve a fully functional system.

3.3 ADJUSTING AND CLEANING

- A. When requested by Architect or Owner within one year of Substantial Completion, provide on-site assistance in adjusting levels and adjusting controls to suit actual occupied conditions.

3.4 UTILITY SCHEDULE

- A. Lighting Control Schedule: Refer to electrical relay panel schedules for lighting relay requirements.
 - 1. Include 5 spare output points for additional lighting control.
- B. Water Control Schedule: Provide water control at plumbing fixtures in Holding areas. Refer to isolation valve schedule/detail for requirements.
 - 1. Include 5 spare output points for additional water control.

END OF SECTION 285500

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SECTION 285900 - SECURITY MANAGEMENT SERVER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this section.

1.2 SYSTEM DESCRIPTION

- A. The SMS data recording engine shall log security commands made within the detention facility as they happen. The SMS shall provide facility administrators the ability to monitor and review all operational aspects of the Security Control System and its operations. The intent is that by recording all actions of the system, it shall provide owner with greater liability protection and system accountability.

B. Software Requirements

1. The Security Management Server (SMS) shall have the following software requirements to allow for seamless Control and future flexibility.

a. Data Logging

- 1) The SCSC shall provide a SMS system with a single point for logging, recording, report generation and backup. Distributed databases are not acceptable.
- 2) The SMS shall be capable of processing 500,000 transactions per day (minimum).
- 3) The SMS shall be capable of communication to multiple PLCs over Ethernet.

b. Archiving & System Management

- 1) The database shall be able to contain up to 5 million transactions prior to the need to archive data.
- 2) Automatic archives shall be user configurable for frequencies of daily, weekly, monthly, quarterly, semi-annual, or yearly. In addition, the user shall be able to select the day of the week or month to create the archives.
- 3) When performing an archive, the user shall be able to select to archive only, archive and delete the archived events from the database, or delete only.
- 4) Archived events shall be viewable in an identical format as the original SMS, using the standard SMS application. The sorting, searching, and reporting generating functionality shall be identical to the standard SMS application as well.
- 5) The system shall notify the user when the transaction register reaches a user definable limit to allow for data archiving. If the database reaches the user defined limit, an automatic archive will be performed so that current logging will not be affected.
- 6) The user shall have the ability to set an expiration date for all archives stored on the SMS computer. Archives that have reached their expiration dates shall be deleted automatically to create additional hard drive space.
- 7) The system shall notify the user when the hard drive reaches a user definable percentage of free hard drive space. If the hard drive reaches the user defined limit, the archives shall be deleted automatically so that current logging will not be affected.

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- 8) The user shall have the ability to perform a full database backup.

C. System Features

1. The Security Management Server (SMS) performs several valuable functions, but is not an essential component of any operational control system. It shall be configured as follows:
 - a. The SMS shall be connected via Ethernet to the PLC controller.
 - b. The SMS shall receive and record alarms and transactions from the PLC within 500 milliseconds of the occurrence. The SMS shall record Time/Date, Device Type, Device Name, Event Name/Description, and the name of the VGUI and operator for VGUI initiated actions.
 - c. Transactions & Alarms shall include, but are not limited to:
 - 1) The SMS shall record to disk all door activities, including unlock requests, unlocking, re-locking, secure actions, door position changes, lock status, alarms, alarm silencing, and alarm resetting.
 - 2) Changing the state of ISOLATED doors is recorded to disk by the SMS.
 - 3) All interlock override activities.
 - 4) The SMS records all intercom call activity, including when the call was placed or audio threshold alarm occurred, when the station was connected to, and when the call was disconnected.
 - 5) Every intercom pushbutton press.
 - 6) All communications ISOLATE activities.
 - 7) All Access control system activities.
 - 8) All pushbutton and request to exit activities.
 - 9) All Duress system activities.
 - 10) All video system activities.
 - 11) All Utility control activities.
 - 12) All PLC system faults.
 - 13) All VGUI login/logout activities.
 - d. All transactions (action codes), alarms and status are continually outputted from the PLC. The PLC shall be able to service this data management activity and continually control all other devices specified elsewhere in this specification without any additional delay in system throughput.
 - e. The SMS will provide preventative maintenance and enhanced analysis functions.
2. The SMS provides the following features:
 - a. If multiple VGUI stations and/or Graphic control panels and/or PLCs are provided, the SMS shall be capable of recording all events of all stations, panels and PLCs.
 - b. Transactions sent to screen, disk or printer are time and date stamped.
 - c. Provide password protection to prevent modifications to the database system.
 - d. All reports/searches shall take less than 60 seconds to generate for the most intensive retrieval.
 - e. The database reports shall include the option to export the data to a comma-separated file (CSV) or an XML file to be used by owner provided software.
3. The SMS will include a complete comprehensive relational database report utility. All reports are titled and time and data stamped. It shall be possible to easily select reports to show the history of any device or group of devices between specified times and dates.

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4. The user shall have the ability to easily display all of the events or to filter the events based on the device type (ex: doors or cameras) or based on a specific device (ex: 'Front Door').
5. The user shall be able to quickly display events for pre-defined time periods such as previous hour, previous 24 hours, previous 7 days, etc.
6. The user shall have the ability to perform an advanced search which allows the operator to select any and all transaction types, alarms, watchtour, time changes and any other system functions as described in the specifications, and is done by defining a start date and time and a stop date and time. The computer will search any applicable matching occurrences and print either to the screen or printer as a report; thus allowing searching for:
 - a. Specific date/time ranges
 - b. Specific device types
 - c. Specific device names
 - d. Specific keyword
 - e. Any combination of the above

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. Computer Hardware configuration

1. The server shall have the following minimum requirements:
 - a. Processor: Intel Xeon E5-2609v3, 1.9GHz, 15MB Cache, 6 Cores
 - b. Operating System: Window Server 2022
 - c. Internal Memory: 32GB, DDR4, 2133 MHz
 - d. Storage: 3-500GB 6G SAS Hard Drives (1.5TB total)
 - e. Storage Type: RAID 5
 - f. Network: 4-Gigabit Ethernet Ports
 - g. Power Supply: Dual, Hot Swappable
2. The server shall have a licensed copy of the HMI software installed.
3. The server shall be administered remotely using any control station on the security network.
4. Approved Manufacturers:
 - a. HP
 - b. Dell
5. Server shall connect to KVM being used for the Video Management System.

END OF SECTION 285900

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SECTION 311000 - SITE PREPARATION

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.
- B. Standards set forth by the North Carolina Department of Environmental Quality (NCDEQ) Division of Energy, Mineral and Land Resources.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Removal of trees and other vegetation.
 - 2. Clearing and grubbing.
 - 3. Removing above-grade improvements.
 - 4. Removing below-grade improvements.
- B. Related Sections:
 - 1. Division 31 Section "Earth Moving".
 - 2. Division 31 Section "Erosion Controls".

1.3 PROJECT CONDITIONS

- A. Traffic: Conduct site-clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks, or other occupied or used facilities without permission from authorities having jurisdiction.
- B. Protection of Existing Improvements: Provide protections necessary to prevent damage to existing improvements indicated to remain in place.
 - 1. Protect improvements on adjoining properties and on Owner's property.
 - 2. Restore damaged improvements to their original condition, as acceptable to property owners.
 - 3. All erosion control measures shall be in place prior to commencement of clearing operations.
- C. Protection of Existing Trees and Vegetation: Protect existing trees and other vegetation indicated to remain in place against unnecessary cutting, breaking or skinning of roots, skinning or bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide temporary guards to protect trees and vegetation to be left standing.
 - 1. Water trees and other vegetation to remain within limits of contract work as required to maintain their health during course of construction operations.

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2. Provide protection for roots over 1-1/2 inch (38 mm) in diameter that are cut during construction operations. Coat cut faces with an emulsified asphalt or other acceptable coating formulated to use on damaged plant tissues. Temporarily cover exposed roots with wet burlap to prevent roots from drying out; cover with earth as soon as possible.
3. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations in a manner acceptable to Engineer. Employ a licensed arborist to repair damage to trees and shrubs.
4. Replace trees that cannot be repaired and restored to full-growth status, as determined by arborist.

- D. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated or directed.

1.4 EXISTING SERVICES

- A. General: Indicated locations are approximate; determine exact locations before commencing Work.
- B. Arrange and pay for disconnecting, removing, capping, and plugging utility services. Notify affected utility companies in advance and obtain approval before starting this Work.
- C. Place markers to indicate location of disconnected services. Identify service lines and capping locations on Project Record Documents.

1.5 PERFORMANCE REQUIREMENTS

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

PART 2 – PRODUCTS

None Used.

PART 3 – EXECUTION

3.1 SITE CLEARING

- A. General: Remove trees, shrubs, grass, and other vegetation, improvements, or obstructions, as required, to permit installation of new construction. Remove similar items elsewhere on site or premises as specifically indicated. Removal includes digging out and off-site removal of stumps and roots.
 1. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
 2. Existing trees within clearing limits may be chipped and stockpiled on-site but shall NOT be used as landscaping mulch or fill.

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- B. Clearing and Grubbing: Clear site of trees, shrubs, and other vegetation, except for those indicated to be left standing.
1. Completely remove stumps, roots, and other debris protruding through ground surface.
 2. Use only hand methods for grubbing inside drip line of trees indicated to remain.
 3. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.
 - a. Place fill material in horizontal layers not exceeding 6 inches (150 mm) loose depth, and thoroughly compact each layer to a density equal to adjacent original ground.
- C. Topsoil Stripping: Strip and stockpile existing topsoil within construction limits for re-spreading. Should the Contractor elect to remove topsoil from the site, suitable topsoil from off-site sources shall be provided for re-spreading at no cost to the Owner.
1. Remove sod and grass before stripping topsoil.
 2. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials. All surface topsoil, regardless of thickness encountered, shall not be considered Unsuitable Soil.
 3. Remove subsoil and non-soil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.
 4. Stockpile topsoil materials within construction limits and away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 5. Do not stockpile topsoil within tree protection zones.
 6. Dispose of excess topsoil off-site.
- D. Removal of Improvements: Remove existing above-grade and below-grade improvements as indicated and as necessary to facilitate new construction.
1. Abandonment or removal of certain underground pipe or conduits may be indicated on mechanical or electrical drawings and is included under work of related Division 22 Sections. Removing abandoned underground piping or conduits interfering with construction is included under this section.

3.2 DEMOLITION PREPARATION

- A. Conduct demolition operations and remove debris to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations or as shown on the drawings.
- B. Conduct demolition operations to prevent injury to people and damage to adjacent buildings and facilities to remain. Ensure safe passage of people around selective site demolition area.

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1. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction or as shown on the plans.
 2. Protect existing site improvements, appurtenances, and landscaping to remain.
 3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
 4. Provide temporary weather protection, during interval between demolition and removal of existing construction, on exterior surfaces and new construction to ensure that no water leakage or damage occurs to structure or interior areas.
- C. Provide and maintain exterior shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of building to be selectively demolished.
1. Strengthen or add new supports when required during progress of selective demolition.
- D. Protect trees, fences, poles, mailboxes, and all other property unless their removal is authorized. Any property damaged, that is not authorized for removal, shall be restored or replaced to the Owner's satisfaction.

3.3 UTILITY SERVICES

- A. Maintain existing utilities indicated to remain in service and protect them against damage during selective site demolition operations.
1. Do not interrupt existing utilities serving occupied or operating facilities, except when authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to governing authorities.
 - a. Provide not less than 72 hours' notice to Owner if shutdown of service is required during changeover.
- B. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services serving building to be selectively demolished.
1. Arrange to shut off indicated utilities with utility companies.
 2. Where utility services are required to be removed, relocated, or abandoned, provide bypass connections to maintain continuity of service to other parts of the building before proceeding with selective demolition.
- C. Utility Requirements: Refer also to Division 21, 22, 23 and 26 Sections for additional requirements for shutting off, disconnecting, removing, and sealing or capping utility services. Do not start selective site demolition work until utility disconnecting and sealing have been completed and verified in writing.
- D. Utility Adjustments and Relocations: Adjust locations, elevations and routes of existing utility lines, poles, guys, vaults, handholes, boxes, and other related appurtenances as required to facilitate new construction. Coordinate adjustments and relocations with utility companies.

3.4 POLLUTION CONTROLS

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- A. Use water mist, temporary enclosures, and other suitable methods to limit the spread of dust and dirt. Comply with governing environmental protection regulations.
 - 1. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
- B. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- C. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective site demolition operations. Return adjacent areas to condition existing before start of selective demolition.

3.5 SELECTIVE SITE DEMOLITION

- A. Demolish and remove existing construction only to the extent required by new construction and as indicated on the drawings. **Completely demolish and remove existing improvements; including footings, utilities and other below-grade elements; as indicated on the drawings.** Use methods required to complete Work within limitations of governing regulations.
 - 1. Dispose of demolished items and materials promptly. On-site storage or sale of removed items is prohibited.
 - 2. Return elements of construction and surfaces to remain to condition existing before start of selective demolition operations.
 - 3. Comply with all applicable regulations during demolition, handling and disposal of all items indicated to be removed or necessary to be removed to allow construction of new work.
- B. Demolish asphalt, concrete and masonry in small sections. Cut concrete and masonry at junctures with construction to remain, using power-driven masonry saw or hand tools; do not use power-driven impact tools.
- C. Remove sawcut concrete and asphalt, including aggregate base, to a depth of 12-inches below existing, adjacent grade, or as indicated. Provide neat sawcut at limits of pavement removal as indicated.

3.6 PATCHING AND REPAIRS

- A. Promptly patch and repair holes and damaged surfaces caused to adjacent construction by selective site demolition operations.
- B. Where repairs to existing surfaces are required, match previous work as closely as possible.
 - 1. Completely fill holes and depressions in existing masonry walls to remain with an approved masonry patching material, applied according to manufacturer's printed recommendations.
- C. Restore exposed finishes of patched areas and extend finish restoration into adjoining construction to remain in a manner that eliminates evidence of patching and refinishing.

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3.7 CLEANING

- A. Keep the site free from debris and hazards and inspect the site at the end of each day for trash. All adjacent roads and drives outside of the construction fencing shall remain in operation during construction and shall remain free of all construction materials and debris.

3.8 DISPOSAL OF WASTE MATERIALS

- A. General: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.
- B. Burning on Owner's Property: Burning is not permitted on Owner's property.
- C. Removal from Owner's Property: Remove waste materials and unsuitable or excess soils and mulch from Owner's property. Transport demolished materials off Owner's property and legally dispose of them.
- D. Recycling: Contractor shall not dispose of excess soil and land clearing debris in landfills. 100% of soil and land clearing debris shall be recycled. Provide documentation verifying 100% recycling of cleared trees and stumps and excess soil materials. Refer to Division 01 section – Construction Waste Management for additional requirements.

END OF SECTION

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SECTION 312000 – EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Report of Subsurface Investigation.
 - 1. The geotechnical report is available to bidders as general information with regard to project and site conditions. However, the geotechnical report is not a part of the contract documents and is not a warranty or guarantee of subsurface conditions. Variations in subsurface conditions should be anticipated. Bidders should carefully inspect the site prior to bidding and will be provided reasonable access to perform independent explorations of subsurface conditions, if requested.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Preparing and grading subgrades for walks, lawn areas, and landscaping.
 - 2. Excavating, filling and backfilling for structures.
 - 3. Base course for walks and pavements.
 - 4. Subsurface drainage backfill for trenches.
 - 5. Excavating and backfilling trenches.
- B. Related Sections: The following Sections contain requirements that relate to this Section.
 - 1. Division 01 Sections for allowances, definitions and procedures.
 - 2. Division 31 Section "Site Clearing" for site stripping, grubbing, topsoil removal, and tree protection.
 - 3. Division 33 Section "Storm Drainage Utilities" for storm drainage.
 - 4. Division 32 Section "Planting" for finish grading, including placing and preparing topsoil for permanent and temporary grass seeding.
 - 5. Division 31 "Erosion and Sediment Controls", for all areas of the site that are graded or disturbed by any construction operations

1.3 UNIT PRICES

- A. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed the following:
 - 1. 24 inches outside of concrete forms other than at footings.
 - 2. 12 inches outside of concrete forms at footings.
 - 3. 6 inches outside of minimum required dimensions of concrete cast against grade.
 - 4. 6 inches beneath bottom of concrete slabs on grade.
 - 5. 6 inches beneath invert elevation of pipe in trenches and the greater of 24 inches wider than pipe outside diameter or 42 inches.

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6. Additional rock removed beyond the limits outlined above to accommodate trench boxes, other removal methods, compaction equipment or other reasons shall not be included in the payment volume.
 7. Any materials paid by Unit Prices to replace excavated rock shall utilize these same measurement limits.
- B. Unsuitable Soil Measurement: Volume of soil actually removed, measured in original position, but not to exceed the limits directed by the Owner's Independent Testing Agency.
1. Additional soil excavated beyond the limits directed by the Owner's Independent Testing Agency; including lay-back of excavation walls, excavation to accommodate trench boxes or other shoring, etc.; shall not be considered Unsuitable Soil.
- C. Soil Reconditioning Measurement: Volume of soil actually removed and reconditioned, measured in original position, but not to exceed the limits directed by the Owner's Independent Testing Agency.
- D. Replacement Material Measurement: Volume exactly equal to that of the unsuitable soil or rock that was removed, measured in original position.
- E. Unit prices for Unsuitable Soil removal, Soil Reconditioning, and Rock removal shall include all work and materials as defined in Division 01 sections.

1.4 DEFINITIONS

- A. Excavation consists of the removal of material encountered to subgrade elevations and the reuse or disposal of materials removed. Refer to the following section for additional definitions of classified excavations.
- B. Subgrade: The uppermost surface of an excavation or the top surface of a fill or backfill immediately below base course, drainage fill, or topsoil materials.
- C. Borrow: Soil material obtained off-site when sufficient approved soil material is not available from excavations.
- D. Surface Course: The top layer of the pavement structure placed on base course or subgrade.
- E. Base Course: Layer placed between the subgrade elevation and asphalt paving courses.
- F. Bedding Course: Layer placed over excavated subgrade in a trench before laying pipe.
- G. Unauthorized excavation consists of removing materials beyond indicated subgrade elevations or dimensions without direction by the Architect. Unauthorized excavation, as well as remedial work directed by the Architect, shall be at the Contractor's expense.
- H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below ground surface.

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- I. Structural Areas: Areas containing Structures and pavement and extending 10-ft beyond the limits of structures and pavements. Structural Areas in fill shall also include the area supporting the fill slope along a 1:1 slope to existing grade. Pavement areas include but are not limited to roads, driveways, parking lots, curbs, sidewalks, dumpster pads, equipment pads, concrete pads, and other similar above grade improvements.
- J. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within building lines.

1.5 EXCAVATION CLASSIFICATIONS

- A. Excavation Classifications: All excavation is classified as General Excavation except for Mass Rock, Trench Rock and Unsuitable Soil Materials as defined in this section.
 - 1. General Excavation: Excavation, removal and/or disposal of pavements and other obstructions visible on surface; underground structures, utilities, and other items indicated to be demolished and/or removed; together with soil, boulders, and other materials encountered that are not classified as rock, unsuitable soil, soil reconditioning, or unauthorized excavation.
 - a. Intermittent drilling, blasting, or ripping to increase production and not necessary to permit excavation of material encountered will be considered general excavation.
 - b. Soil (regardless of nature) or other debris encountered above proposed subgrade elevations shall be considered general excavation unless determined by the Architect to meet the definition of rock.
 - c. In-place densification by vibratory rolling of existing soils at exposed subgrades, as described herein, shall be considered General Excavation.
 - 2. Unsuitable Soil Excavation: Removal and disposal of soil materials or other debris encountered below proposed subgrade elevations which is deemed unsuitable to remain in place by the Architect or Owner's Independent Testing Agency.
 - a. Soil and/or other debris encountered above proposed subgrade elevations shall be considered general excavation.
 - b. Soil material which, in the opinion of the Architect or Owner's independent testing agency, can be repaired by scarifying, drying and recompacting or material which is made unsuitable by delay of work, lack of protection or other actions of the Contractor or his Sub-Contractors shall not be considered as unsuitable soil and shall be repaired or replaced by the Contractor at no additional cost to the Owner. Moisture content alone shall not be the determining factor as to the presence of unsuitable soil.
 - c. Any material moved or removed without the measurement by the Owner's independent testing agency and approval by the Architect will be considered as general excavation.
 - d. Surface topsoil, regardless of thickness encountered, shall not be considered unsuitable soil.
 - e. Stones, rocks and boulders not meeting classifications of rock shall not be considered unsuitable soil. Stones, rocks and boulders shall be removed from soil

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as necessary if soil is to be used as fill or backfill. Removed stones, rocks and boulders shall be removed from the site.

- f. The unsuitable soil allowances shall be for unsuitable soils only and not for repair of weather related deterioration of subgrade. These Allowances are not for required on-site cut and off-site fill necessary to bring subgrades and grades to elevations shown on drawings. Contractor shall be responsible for proper drying and dewatering procedures, as necessary, as part of his normal operations.
3. Soil Reconditioning: Removal, moisture conditioning and re-compaction of in-situ soil materials encountered 6-inches or more below proposed subgrade elevations which is deemed too loose to remain in place by the Architect or Owner's Independent Testing Agency but is otherwise suitable for structural subgrade with proper compaction and moisture conditioning.
- a. Loose soil encountered within 6-inches below or at any depth above proposed subgrade elevations shall be considered General Excavation. Soils encountered up to 6-inches below proposed subgrade shall be moisture conditioned and compacted as General Excavation.
 - b. Soil material which, in the opinion of the Architect or Owner's independent testing agency, which is made loose by actions of the Contractor or his Sub-Contractors shall not be considered as loose soil reconditioning and shall be repaired or replaced by the Contractor at no additional cost to the Owner.
 - c. Any material reconditioned without the measurement by the Owner's independent testing agency and approval by the Architect will be considered as General Excavation.
 - d. Surface topsoil, regardless of thickness encountered, shall not be considered as Soil Reconditioning.
4. Mass rock Excavation: Removal, in Open Excavations, of rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1.5-cu.yd. that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted. In the event rock (as defined above) is encountered, the Contractor shall immediately notify the Architect.
- a. Mass Rock Excavation Equipment: Late-model, track-type CAT D-8 crawler tractor operating at one mile per hour in the lowest available gear, and at the highest normal operating rpm pulling a sharp, single-toothed ripper. The Contractor shall provide equipment specification and test data verifying that the equipment to be used for demonstration purposes complies with the minimum requirements. The equipment shall be in good repair and in proper working condition. The Owner reserves the right to inspect and approve the equipment to be used for demonstration purposes. The Contractor shall demonstrate (at no additional cost) to the Architect or Owner's independent testing agency that the rock cannot be practically ripped with equipment equivalent that specified above without systematic drilling and blasting. Mass rock is defined as material which, after 1 hour of continuous ripping using the equipment described above, produces less than 30 cubic yards of removable material.

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5. Trench Rock Excavation: Removal, in Trench Excavations, of rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1.0-cu.yd. that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted. In the event rock (as defined above) is encountered, the Contractor shall immediately notify the Architect.
 - a. Trench rock excavation equipment: Late-model, track mounted CAT 330 or equivalent hydraulic excavator equipped with a narrow (36" max) bucket with new rock teeth and operating at the highest normal operating RPM. The Contractor shall provide equipment specification and test data verifying that the equipment to be used for demonstration purposes complies with the minimum requirements. The equipment shall be in good repair and in proper working condition. The Owner reserves the right to inspect and approve the equipment to be used for demonstration purposes. Trench rock is defined as material which, after 1 hour of continuous digging using the equipment described above, removes less than 10 cubic yards of material.
6. Classified excavation requirements:
 - a. Excavations more than both 10 feet in width and more than 30 feet in length are defined as Open Excavations. Excavations less than both 30 feet in width and less than 30 feet in length are defined as Trench Excavations.
 - b. Contractor shall expose and clean the rock material for inspection and measurement by the Architect.
 - c. Do not excavate rock or unsuitable soil until it has been classified and cross-sectioned by the Owner's independent testing agency or Architect. Any material moved or removed without the measurement by the Owner's independent testing agency and approval by the Architect will be considered as General Excavation.
 - d. The Architect shall be the final judge on what is classified as unsuitable or rock excavation.
 - e. The contractor may be required to provide equipment specification data verifying that the above minimum-rated equipment will be used for demonstration purposes. The equipment shall be in good repair and in proper working condition.
 - f. Rippable rock, weathered rock or overburden which is not classified as rock according to the above definitions shall be considered General Excavation.

1.6 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Test Reports: In addition to test reports required under field quality control, submit the following:
 1. Laboratory analysis of each soil material proposed for fill and backfill from on-site and borrow sources.
 2. One optimum moisture-maximum density curve for each soil material.
 3. Reports of all laboratory and field tests including evaluations of subgrades and foundation bearing conditions.

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4. Reports of Special Inspections.

- C. Blasting plan approved by authorities having jurisdiction if applicable due to on-site rock.
- D. Report of rock or unsuitable soil removal with quantities confirmed in writing by the Architect or Owner's independent testing agency.

1.7 QUALITY ASSURANCE

- A. Codes and Standards: Perform earthwork complying with requirements of authorities having jurisdiction. Any earthwork required for preparation of parking areas and drives shall comply with current NCDOT Standard Specifications as per the North Carolina Construction Manual.
- B. Comply with applicable requirements of NFPA 495--Explosive Materials Code.
- C. Testing and Inspection Service: Owner will employ a qualified independent geotechnical engineering testing agency to classify proposed on-site and borrow soils to verify that soils comply with specified requirements and to perform required field and laboratory testing.
- D. Special Inspections: Owner will employ a qualified Special Inspector or Special Inspection Agency to perform verification and inspection of earthwork construction in accordance with NC State Building Code.
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1
 - 1. Before commencing earthwork, meet with representatives of the governing authorities, Owner, Architect, consultants, Geotechnical Engineer, independent testing agency, and other concerned entities. Review earthwork procedures and responsibilities including testing and inspection procedures and requirements. Notify participants at least 3 working days prior to convening conference. Record discussions and agreements and furnish a copy to each participant.
- F. Lime or Cement soil stabilization shall be performed by a pre-qualified contractor having experience with successfully stabilizing subgrades in the general project area on similar sized projects with similar soil conditions.

1.8 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt existing utilities serving facilities occupied by the Owner or others except when permitted in writing by the Architect and then only after acceptable temporary utility services have been provided.
 - 1. Provide a minimum 48-hours' notice to the Architect and receive written notice to proceed before interrupting any utility.
- B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shutoff services if lines are active.

1.9 PAYMENT

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- A. General Excavation: All general excavation to the lines and grades indicated on the drawings including all necessary off-site disposal of excess materials and/or off-site borrow of fill materials shall be included in the base bid.
 - 1. No statement is made or implied that the on-site grading and earthwork indicated on the drawings is balanced.
- B. Unsuitable Soil Material Excavation: Unsuitable soil material excavation will be paid by unit prices included in the Contract Documents.
 - 1. Unused amounts of monies included under allowances shall be credited to the Owner by deduct change order.
- C. Rock Excavation: Mass rock and Trench rock excavation will be paid by unit prices included in the Contract Documents.
 - 1. Unused amounts of monies included under allowances shall be credited to the Owner by deduct change order.
- D. Soil Reconditioning: Soil Reconditioning will be paid by unit prices included in the Contract Documents.
 - 1. Unused amounts of monies included under allowances shall be credited to the Owner by deduct change order.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide approved borrow soil materials from off-site when sufficient approved soil materials are not available from excavations.
- B. Satisfactory Soil Materials: ASTM D 2487 soil classification groups GW, GC, GP, GM, ML, CL, SW, SP, SC, and SM; free of rock or gravel larger than 2 inches (50 mm) in any dimension, debris, waste, frozen materials, vegetation and other deleterious matter. Additionally, satisfactory soil for use in structural fill areas shall meet the following:
 - 1. Have a Plasticity Index of 20 or less and a Liquid Limit of 50 or less.
 - 2. Shall have a Standard Proctor Maximum Dry Density of 90-lb/cf or greater.
 - 3. Satisfactory soil materials obtained from off-site borrow sources shall meet all requirements listed above and possess a Standard Proctor Maximum Dry Density of 90-lb/cf or greater, shall contain at least 20% fines, and have a Plasticity Index of less than 20.
 - 4. CH and MH soils having plasticity indices greater than 20 may also be used as fill in deep fill sections placed at -1% to +3% of optimum and at least 3-ft below planned subgrade elevations in pavement, building or other structural areas.
 - 5. Soils having a Plasticity Index greater than 25 and a Liquid Limit greater than 50 may be used as fill in approved non-structural areas.

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- C. Unsatisfactory Soil Materials: ASTM D 2487 soil classification groups MH, CH, OL, OH, and PT. Soils having a Plasticity Index greater than 20 and a Liquid Limit greater than 50 are also unsatisfactory within structural (pavement and building) areas except if placed as specified above.
- D. Excavated Rock Materials Backfill: Excavated weathered rock and blasted rock is suitable for use as fill if placed as follows under the direction and observation of the Owner's independent testing agency:
 - 1. Rock pieces shall not exceed 3-inches in any direction.
 - 2. Rock materials shall be thoroughly mixed with suitable soil prior to compaction to prevent voids.
 - 3. Rock materials shall not be placed within 3-ft of pavement subgrade, or within the initial 2-feet of backfill of over utilities.
 - 4. In no case shall fill lifts consisting predominantly of rock be placed nor shall boulders or rock pieces be stacked on top of each other.
- E. Unsuitable Soil: Refer to paragraph 1.5 of this Section.
- F. Backfill and Fill Materials: Satisfactory soil materials.
- G. Impervious Fill & Clay Liner: Clayey or silty soil mixtures capable of compacting to a dense state with a maximum permeability of 0.01-in/hr and compacted to at least 95% of the maximum dry density per ASTM D-698. ASTM D 2487 soil classification groups CH, CL, SC, MH, and ML; free of rock, brush, roots, and other organic material subject to decomposition.

2.2 PROCESSED AGGREGATE MATERIALS

- A. Base Course Material: Type A aggregate base course meeting the requirements of Section 520 of NCDOT "Standard Specifications for Roads and Structures."
- B. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- C. Bedding Material: #57 washed stone.
- D. Drainage Fill: #57 washed stone.
- E. Filtering Material: #57 washed stone.
- F. Coarse Sand: Grain Size Distribution (ASTM C136-95A):

<u>Sieve Size</u>	<u>Percent Passing</u>
3/8"	100
#4	95-100
#8	85-97
#16	60-80
#30	10-20
#50	5-15

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2.3 LEAN CONCRETE FILL

- A. Lean concrete fill shall consist of a mixture of portland cement, aggregate and water. Water reducing and air-entraining admixtures may be added at the option of the Contractor.
 - 1. Material shall comply with the requirements of Division 03 Section, Cast-in-Place Concrete.
 - 2. The proportions of the mix shall be determined by the Contractor to obtain a compressive strength of 700-psi at 7-days.

2.4 FLOWABLE FILL

- A. Flowable fill shall consist of a lean concrete mixture of portland cement, aggregate and water. Water reducing and air-entraining admixtures may be added at the option of the Contractor.
 - 1. Material shall comply with the requirements of Division 03 Section, Cast-in-Place Concrete.
 - 2. The proportions of the mix shall be determined by the Contractor to obtain a compressive strength of 100-300-psi at 28-days.

2.5 CONTROLLED LOW-STRENGTH MATERIAL

- A. Controlled Low-Strength Material: Self-compacting, flowable concrete material produced from the following:
 - 1. Portland Cement: ASTM C 150, Type II.
 - 2. Fly Ash: ASTM C 618, Class C or F.
 - 3. Normal-Weight Aggregate: ASTM C 33, 3/8-inch nominal maximum aggregate size.
 - 4. Water: ASTM C 94/C 94M.
 - 5. Air-Entraining Admixture: ASTM C 260/C 260M.
- B. Produce conventional-weight, controlled low-strength material with 140-psi compressive strength when tested according to ASTM C 495.

2.6 ACCESSORIES

- A. Drainage (Filter) Fabric: Woven monofilament filtration geotextile, specifically manufactured as a drainage geotextile; made from polypropylene yarns; and with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods.
 - 1. Tensile Strength: 200 lb; ASTM D 4632.
 - 2. Tear Strength: 60 lb; ASTM D 4533.
 - 3. CBR Puncture: 700 lb; ASTM D 6241.
 - 4. Water Flow Rate: 18 gpm per sq. ft.; ASTM D 4491.
 - 5. Apparent Opening Size: No. 70; ASTM D 4751
 - 6. Percent Open Area: 4%; CW-02215

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- B. Separation/Stabilization Fabric: Woven geotextile, specifically manufactured for use as a separation and or stabilization geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods:
1. Grab Tensile Strength: 200 lbf (890 N); ASTM D 4632.
 2. Tear Strength: 75 lbf (333 N); ASTM D 4533.
 3. Puncture Resistance: 90 lbf (400 N); ASTM D 4833.
 4. Water Flow Rate: 4 gpm per sq. ft. (2.7 L/s per sq. m); ASTM D 4491.
 5. Apparent Opening Size: No. 30 (0.6 mm); ASTM D 4751.
- C. Biaxial Geogrid: Integrally formed biaxial geogrid, specifically manufactured for use as a base reinforcement for subgrade improvement. Tensar BX1100, Mirafi BXG-110, or approved equal with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods:
1. Aperture Dimensions: 1-in (25-mm) nominal.
 2. Minimum Rib Thickness: 0.03-in (0.76-mm) nominal.
 3. Tensile Strength @ 2% Strain: 280-lb/ft (4.1 kN/m); ASTM D-6637.
 4. Tensile Strength @ 5% Strain: 580-lb/ft (8.5 kN/m); ASTM D-6637.
 5. Ultimate Tensile Strength: 850-lb/ft (12.4 kN/m); ASTM D-6637.
- D. Type IV Stabilization Fabric: Woven geotextile, specifically manufactured for use as a stabilization geotextile complying with NCDOT Type IV geotextile requirements; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods:
1. Elongation: <50%; ASTM D 4632.
 2. Grab Tensile Strength: 180 lbs; ASTM D 4632.
 3. Tear Strength: 70 lbs; ASTM D 4533.
 4. Puncture Strength: 370 lbs; ASTM D 6241.
 5. Permittivity: 0.05 sec⁻¹; ASTM D 4491.
 6. Apparent Opening Size: No. 40 US Sieve; ASTM D 4751.
 7. UV Stabilization: 50%; ASTM D 4355.
- E. Type V Stabilization Fabric: Woven geotextile, specifically manufactured for use as a high-performance stabilization geotextile complying with NCDOT Type V geotextile requirements; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods:
1. Grab Elongation: <20%; ASTM D 4632.
 2. Grab Tensile Strength: 250 lbs; ASTM D 4632.
 3. Wide Width Tensile (Ultimate): 2,400 lb/ft; ASTM D4595.
 4. Tear Strength: 100 lbs; ASTM D 4533.
 5. Puncture Strength: 1,000 lbs; ASTM D 6241.
 6. Permittivity: 0.5 sec⁻¹; ASTM D 4491.
 7. Apparent Opening Size: No. 30 US Sieve; ASTM D 4751.
 8. UV Stabilization: 80%; ASTM D 4355.

PART 3 - EXECUTION

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3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.
- C. Provide erosion control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- D. Site Maintenance: The Contractor shall be responsible to take whatever measures are necessary to ensure reasonable accessibility to and on the construction site so that undue delays are avoided under normal weather conditions. These measures shall include, but not be limited to, the following:
 - 1. Maintaining the surface of the soils in a manner to promote drainage runoff and avoid ponding of water, especially prior to predicted rain events.
 - 2. Avoiding operation of temporary water sources or hoses in a manner which will cause unnecessary and repeated wetting of the site.
 - 3. Fill in severely rutted areas which are ponding water during the construction activities or after rain events with drainage fill material to assist drying and allow construction activities to continue.
 - 4. Provide drying of surface soils and soils intended for filling or backfilling as required to promote accelerated drying of those materials.
 - 5. After successful drying efforts or prior to predicted rain events, grade the areas back to a smooth condition to promote drainage runoff.
 - 6. Controlling vehicular traffic, both construction and personal on the site in a manner to prevent undue damage to soils whenever possible and practical.
 - 7. Providing temporary staging areas of crushed stone or other materials around the construction site which will better withstand the weather and traffic and keep the site accessible immediately or shortly after rain events.
 - 8. Provide de-watering equipment for any areas collecting water which may affect construction or soil densities under built areas.
 - 9. Any claims for weather related delays considered shall be considered with particular attention paid to the Contractor's efforts in regard to the above requirements

3.2 DEWATERING

- A. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

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2. Install a dewatering system to keep subgrades dry and convey groundwater away from excavations. Maintain until dewatering is no longer required.
- C. Design, furnish, install, test, operate, monitor, and maintain temporary dewatering systems of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.
1. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls as needed.
 2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.
 3. Continuously monitor and maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, prevention of flooding in excavation, and prevention of damage to subgrades and permanent structures.
 4. Prevent surface water from entering excavations by grading, dikes, or other means.
 5. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
 6. Remove dewatering system when no longer required for construction.
- D. Soft wet soils, if present at the surface, shall be dried and compacted in place by the Contractor and be stable under proofrolling prior to placing fill. Drying shall be accomplished by discing, plowing or other means necessary and shall be included in the Contractor's bid. Site soils are typical of the area and susceptible to loss of strength if they become wet, resulting in softening and rutting during construction. Site soils are extremely moisture sensitive, therefore, the Contractor shall take active and aggressive steps to dry soil materials wet of optimum to maintain construction progress through the work and to maintain access to and around the construction. The Contractor, at his option and cost may remove unstable, wet materials and replace with available fill materials in lieu of accomplishing soil drying procedures.

3.3 EXPLOSIVES

- A. Explosives: Do not use explosives without written permission of local authorities. Contractor shall provide all consultation, engineering, supervision, expertise, experience, and test blasting as required to protect surrounding structures and to meet the performance requirements of the local authorities.
1. Apply for the appropriate blasting permit with the authorities having jurisdiction and follow the permit requirements.
 2. Contractor shall be responsible for any permit fees.
 3. The requirements associated with the blasting permit are the responsibility of the contractor and no additional payment will be made for additional work related to the blasting operations.
 4. Contractor shall engage the services of a qualified blasting engineer to develop blasting procedures and assist in monitoring blasting operations.
 5. Contractor shall perform pre-blast and post-blast surveys of all utilities, structures, and other facilities adjacent to the blast site and shall perform blast monitoring to ensure no damage is caused to existing structures and other facilities.

3.4 STABILITY OF EXCAVATIONS

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- A. Comply with local codes, ordinances, and requirements of authorities having jurisdiction to maintain stable excavations. Contractor is responsible for ensuring all excavation operations and other construction comply with applicable OSHA requirements. Contractor shall provide temporary shoring and bracing as needed to construct the proposed improvements and comply with the above requirements.

3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
- B. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades.

3.7 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated slopes, lines, depths, and invert elevations.
 - 1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
- B. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit, unless otherwise indicated.
 - 1. Clearance: As indicated
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove stones and sharp objects to avoid point loading.
 - 1. For pipes or conduit less than 6 inches (150 mm) in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
 - 2. For pipes and conduit 6 inches (150 mm) or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
 - 3. Where encountering rock or another unyielding bearing surface, carry trench excavation 6 inches (150 mm) below invert elevation to receive bedding course.

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- D. Soil excavated from trenches that is to be used as backfill or fill shall be moisture conditioned as needed prior to placement and compaction as backfill or fill.

3.8 APPROVAL OF SUBGRADE PRIOR TO PLACING FILL OR OTHER IMPROVEMENTS

- A. Notify Architect or Owner's independent testing agency when excavations have reached required subgrade.
- B. After stripping is complete the exposed subgrade shall be proofrolled with a fully loaded dual wheel tandem axle dump truck or similar construction equipment. Four passes shall be made in each orthogonal direction. The proofrolling operation shall be observed by the Architect or Owner's independent testing agency. Should any area fail to tighten up after proofrolling and continue to rut and/or pump, the soil shall be scarified and moistened or aerated and recompacted and/or densified in-place with a vibratory roller. Repeat proofrolling operations.
 - 1. Proofrolling in confined areas inaccessible to dump trucks shall be performed by other means as determined appropriate by the Owner's independent testing agency.
- C. When Architect or Owner's independent testing agency determines that unforeseen unsuitable soil is present, continue excavation and replace with compacted backfill or fill material as directed.
 - 1. Unforeseen additional excavation and replacement with suitable material approved by the Architect will be considered unsuitable material and will be paid by unit prices included in the Contract Documents. Refer to Division 1 Sections.
- D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect. Install french drains at design subgrade if directed by the Owner's independent testing agency and approved by the Architect.

3.8a IN-PLACE DENSIFICATION OF EXISTING SOILS

- A. After removing the existing buildings, vegetation and pavements, proposed paved areas shall be densified in-place with a medium weight vibratory roller to improve the support of the exposed subgrade soils. Three to six passes shall be made in each orthogonal direction. Vibratory rolling shall be performed during dry weather. If water is brought to the surface during vibratory rolling, discontinue rolling until the water subsides. The vibratory rolling operations shall be observed by the Owner's independent testing agency.
- B. Allow pore pressures to dissipate for at least 12 hours following completion of vibratory rolling. After waiting period, re-perform proofrolling of the densified area.

3.9 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending indicated bottom elevation of concrete foundation or footing to excavation bottom, without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position when acceptable to the Architect.

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1. Fill unauthorized excavations under other construction as directed by the Architect or the Owner's independent testing agency.

- B. Where indicated widths of utility trenches are exceeded, provide stronger pipe, or special installation procedures, as required by the Architect.

3.10 STORAGE OF SOIL MATERIALS

- A. Stockpile excavated materials acceptable for backfill and fill soil materials, including acceptable borrow materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent wind-blown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

- A. Backfill excavations promptly, but not before completing the following:

1. Acceptance of construction below finish grade including, where applicable, damp-proofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for record documents.
3. Testing, inspecting, and approval of underground utilities.
4. Concrete formwork removal.
5. Removal of trash and debris from excavation.
6. Removal of temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
8. Removal of objectionable materials, including rocks larger than acceptable size, from backfill soils.

3.12 UTILITY TRENCH BACKFILL

- A. Place and compact bedding course on rock and other unyielding bearing surfaces and to fill unauthorized excavations. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- B. Pipe sleeves and concrete backfill trenches that carry below or pass under footings and that are excavated within 18 inches (450 mm) of footings. Place concrete to level of bottom of footings. Contact the Architect or the Owner's independent testing agency to coordinate details, procedures and possible alternatives.
- C. Provide 4 inch (100 mm) thick concrete base slab support for piping or conduit less than 30 inches (750 mm) below surface of roadways. After installation and testing, completely encase piping or conduit in a minimum of 4 inches (100 mm) of concrete before backfilling or placing roadway base course.
- D. Place and compact initial backfill of satisfactory soil material or base course material, free of particles larger than 1 inch (25 mm), to a height of 12 inches (300 mm) over the utility pipe or conduit.

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1. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.
 2. Moisture condition soil materials as needed prior to placement as backfill.
- E. Coordinate backfilling with utilities testing.
- F. Fill voids with approved backfill materials as shoring and bracing, and sheeting is removed.
- G. Place and compact final backfill of satisfactory soil material to final subgrade.
1. Moisture condition soil materials as needed prior to placement as backfill.
- H. Install detectable warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.
- 3.13 FILL
- A. Preparation: Remove vegetation, topsoil, debris, wet, frozen, and unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placing fills.
1. Plow, strip or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing surface.
- B. Obtain approval of subgrade as specified prior to placing fill.
- C. Obtain approval of fill materials. Remove all objectionable materials, including stones larger than acceptable size, from fill materials. Large stones may be placed in approved non-structural areas if they are spread evenly, individually and surrounded with properly compacted soil fill to ensure the absence of voids in the fill. Large stone placement in fill shall be monitored by the Owner's Independent Testing Agency.
- D. Place fill material in layers to required subgrade elevations for each location listed below.
1. Under grass, use satisfactory excavated or borrow soil material.
 2. Under walks, pavements, buildings and other structural areas use base course material, or satisfactory excavated or borrow soil material.
 3. In pond embankments, use impervious fill for core/cut-off trench and suitable soil for remainder of embankment.
- E. Following placement of fill the subgrade of building and pavement areas shall be proofrolled as described in the Field Quality Control section. The proofrolling operation shall be observed by the Owner's testing agency. Should any area fail to tighten up after proofrolling and continue to rut and/or pump, the soil shall be scarified and moistened or aerated and recompacted. Repeat proofrolling operations.
- F. Deep Fill Settlement: Areas of the site to receive more than 7 feet of fill shall be filled to subgrade elevations and allowed to settle prior to additional construction on the fill. Deep fill settlement hubs shall be installed and monitored until fill settlements have stabilized to the satisfaction of the Owner's independent testing agency.

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- G. Deep Fill Settlement Hubs: Install at least 5 settlement hubs (24-in long rebar or similar) at the surface of fill in the building area where fill depths exceed 7 feet. A licensed surveyor shall record daily elevation measurements of hubs and provide data to the Architect and the Owner's independent testing agency. Do not begin building construction until the Owner's independent testing agency has confirmed that any fill-induced settlement has subsided and approval to proceed is granted by the Architect.
- H. Overbuild Deep Fill Slopes: Fill slopes shall be overbuilt a sufficient distance and then cut back to achieve required compaction at the design slope surface.

3.14 MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 3 percent of optimum moisture content.
 - 1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Remove and replace or scarify and air-dry satisfactory soil material that is too wet to compact to specified density.
 - a. Stockpile or spread and dry removed wet satisfactory soil material.
- B. Lime-Assisted Soil Drying: Soils that cannot be dried through conventional discing methods may be dried by lime-assisted drying as directed by the Owner's independent testing agency.
 - 1. Contractor shall determine the amount of quicklime required to dry soils.
 - 2. Lime-assisted soil drying to be applied to the Contract Allowances shall be performed only after attempts at conventional drying, to the satisfaction of the Architect, have failed.

3.15 COMPACTION

- A. Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill materials evenly on all sides of structures to required elevations. Place backfill and fill uniformly along the full length of each structure.
- C. Percentage of Maximum Dry Density Requirements: Compact soil to not less than the following percentages of maximum dry density according to ASTM D698 Standard Proctor:
 - 1. Under structures, steps, walks, and pavements:
 - a. Compact each layer of backfill or fill material at 95% of the standard Proctor Density (ASTM D-698).
 - b. Compact each layer of the final 12-in of backfill material in building and pavement areas at 98% of the standard Proctor Density (ASTM D-698).
 - c. Moisture content of the fill during placement shall be kept within +/-2% of optimum.

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- d. Under pavements within NCDOT rights-of-way or new pavement to be constructed to NCDOT standards compact the top 8 inches below pavement subgrade to at least 100% density in accordance with AASHTO T-99 as modified by NCDOT.
2. Under lawn or unpaved areas, compact the top 6 inches below subgrade and each layer of backfill or fill material at 90 percent maximum dry density.
3. In pond embankments, compact each layer of backfill or fill material at 95% of the standard Proctor Density (ASTM D-698). Moisture content of the fill during placement shall be kept within 0% to +3% of optimum.
4. Compact each layer of aggregate base material under pavement to 100% density in accordance with AASHTO T-180 as modified by NCDOT or to at least 98% of the nuclear target density as specified in section 520 of the NCDOT Standard Specifications for Roads and Structures.

3.15a LIME STABILIZATION

- A. Lime-Stabilization of Subgrade: Mix lime into the uppermost 12-inches of highly-plastic subgrade soils in pavement and building areas where directed by the Owner's Independent Testing Agency. Perform lime-stabilization in accordance with Section 501 of the 2012 NCDOT "Standard Specifications for Roads and Structures." Lime stabilization shall only be performed when the air temperature is above 45°F. Lime shall only be applied in areas that can be initially mixed and sealed during the day of application. Lime shall not be applied in windy conditions. The hazards of chemicals blowing across the site or onto adjacent property should also be addressed.
- B. Results of chemical analysis of the additive materials shall be provided to the Owner's independent testing agency prior to use.
- C. Following the establishment of subgrade elevations, perform the following:
 1. Scarify and partially pulverize the soil. Condition soil as needed to reach proper moisture content.
 2. Spread quicklime at a rate of 4 to 6 percent by dry weight of the top 12-in of soil.
 3. Rotor mix lime with the top 12-in of soil while hydrating the lime.
 4. Allow soil to mellow for a sufficient period of time.
 5. Continue rotor mixing and pulverizing lime amended soil to achieve thorough mixing. Obtain proper moisture content of the soil/lime mix.
 6. Compact the soil/lime mix to required compaction level.
 7. Ensure Owner's Independent Testing Agency is present throughout the lime stabilization process.

3.15b CEMENT DRYING OF SUBGRADE SOIL

- A. Cement Drying of Subgrade Soil: Mix cement into the uppermost 12-inches of subgrade soils in pavement and building areas where directed by the Owner's Independent Testing Agency. Perform cement drying in accordance with Section 542 of the 2018 NCDOT "Standard Specifications for Roads and Structures." Cement drying shall only be performed when the air temperature is above 40°F. Cement shall only be applied in areas that can be initially mixed and sealed during the day of application. Cement shall not be applied in windy conditions. The hazards of chemicals blowing across the site or onto adjacent property should also be addressed.

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- B. Results of chemical analysis of the additive materials shall be provided to the Owner's independent testing agency prior to use.
- C. Where cement drying is deemed necessary by the Architect and Owner's independent testing agency, perform the following:
 - 1. Spread cement at a rate of 3 percent by dry weight of the top 12-in of soil. Use mechanical spreaders that have an adjustable rate of flow and capability of spreading the required amount of cement in one pass.
 - 2. Rotor mix cement with the top 12-in of soil while hydrating the cement. Perform all mixing with a self-propelled rotary mixer. Disc harrows, motor graders and other equipment may be used only to supplement the mixing done by the rotary mixer.
 - 3. Continue rotor mixing and pulverizing cement amended soil to achieve thorough mixing.
 - 4. Compact the soil/cement mix to required compaction level.
 - 5. Ensure Owner's Independent Testing Agency is present throughout the cement drying process.

3.15c CEMENT DRYING OF ON-SITE FILL SOIL

- A. Cement Drying of On-Site Fill Soil: Mix cement into existing soil prior to placing as fill as directed by the Owner's Independent Testing Agency. Cement drying shall only be performed when the air temperature is above 40°F. Cement shall only be added to soils that can be initially mixed and compacted in-place during the day of application. Cement shall not be applied in windy conditions. The hazards of chemicals blowing across the site or onto adjacent property should also be addressed.
- B. Results of chemical analysis of the additive materials shall be provided to the Owner's independent testing agency prior to use.
- C. Where cement drying is deemed necessary by the Architect and Owner's independent testing agency, perform the following prior to placement of on-site soils as fill or backfill:
 - 1. Condition soil as needed to reach proper moisture content.
 - 2. Add cement to soil at a rate of 3 percent by dry weight. Use mechanical spreaders that have an adjustable rate of flow and capability of spreading the required amount of cement in one pass.
 - 3. Mix cement with soil while hydrating the cement. Perform all mixing with a self-propelled rotary mixer. Disc harrows, motor graders and other equipment may be used only to supplement the mixing done by the rotary mixer.
 - 4. Continue mixing and pulverizing cement amended soil to achieve thorough mixing. Obtain proper moisture content of the soil/cement mix.
 - 5. Place and compact the soil/cement mix to required compaction level.
 - 6. Ensure Owner's Independent Testing Agency is present throughout the cement drying process.

3.16 GRADING

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- A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between existing adjacent grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to conform to required surface tolerances.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 - 1. Lawn or Unpaved Areas: Plus or minus 1.2 inches (0.10 foot).
 - 2. Walks: Plus or minus 1.2 inches (0.10 foot).
 - 3. Pavements: Plus or minus 1/2 inch (0.05 foot).
- C. Lawn Fine Grading: Finish grade lawn and field areas to a smooth, even surface with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted in the immediate future. Remove trash, debris, stones larger than 1/2 inch in any dimension, and other objects that may interfere with planting or maintenance operations. Remove all glass, wire or other objects of any size which may cause injury. Surfaces shall be top dressed with sterile sand following establishment of grass as necessary to obtain smooth, consistent surface.

3.17 SUBSURFACE / FOUNDATION DRAINAGE

- A. Drainage Piping: Drainage pipe is specified in Division 33 Section "Site Storm Drainage Utilities."
- B. Subsurface Drain: Place a layer of drainage fabric around perimeter of drainage trench as indicated. Place a course of drainage fill material on drainage fabric to support drainage pipe. Encase drainage pipe in drainage fill material and wrap in drainage fabric, overlapping sides and ends at least 6 inches.
 - 1. Compact each course of drainage fill material.
 - 2. Place satisfactory excavated or borrow soil material or topsoil fill material (as appropriate) over drain to final grade.

3.18 BASE COURSES

- A. Under pavements, walks, courts and tracks, place base course material on prepared subgrades.
 - 1. Where indicated, place biaxial geogrid directly on prepared subgrade under all asphalt and concrete pavement without wrinkles or folds. Seams shall be overlapped a minimum of 12-in. Geogrid placement shall be observed by the Owner's Independent Testing Agency prior to covering. Place compacted base course over geogrid and control traffic and operation of equipment over geogrid and base course in accordance with manufacturer's instructions.
 - 2. Compact base courses at optimum moisture content to required grades, lines, cross sections and thickness to not less than 100 percent density in accordance with AASHTO

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T-180 as modified by NCDOT or to at least 98% of the nuclear target density as specified in section 520 of the NCDOT Standard Specifications for Roads and Structures.

3. Shape base course to required crown elevations and cross-slope grades.
4. When thickness of compacted base course is 6 inches or less, place materials in a single layer.
5. When thickness of compacted base course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick when compacted.
6. Following compaction testing and within 48 hours prior to the application of asphalt or concrete pavement, the aggregate base course shall be proofrolled with a fully loaded dual wheel tandem axle dump truck or similar construction equipment. Four passes shall be made in each orthogonal direction. The proofrolling operation shall be observed by the Architect or Owner's independent testing agency. Should any area fail to tighten up after proofrolling and continue to rut and/or pump, the base course shall be scarified and moistened or aerated and recompacted. Repeat proofroll testing.
 - a. Proofrolling in confined areas inaccessible to dump trucks shall be performed by other means as determined appropriate by the Owner's independent testing agency.

- B. Pavement Shoulders: Place shoulders along edges of base course to prevent lateral movement. Construct shoulders at least 12 inches (300 mm) wide of acceptable soil materials and compact simultaneously with each base course layer.

3.19 FIELD QUALITY CONTROL

- A. Owner's Independent Testing Agency Services: Allow testing agency to evaluate and test each subgrade and each fill or backfill layer. Do not proceed until test results for previously completed work verify compliance with requirements.
1. Perform testing and evaluation of borrow or fill soils for compliance with material specifications of this Section.
 2. Perform field in-place density tests according to ASTM D 1556 (sand cone method), ASTM D6938 (nuclear gauge method) or equal as determined by the Owner's independent testing agency.
 - a. Structural Areas: At subgrade and at each compacted fill, backfill layer, and aggregate base course layer, perform at least one field in-place density test for every 2,500 sq.ft. or less of building area and every 5,000 sq.ft. or less of paved area, but in no case fewer than three tests. Observe proofrolling of finished subgrade and aggregate base course.
 - b. Trench Backfill: Perform at least one field in-place density test per 2 feet of backfill per 100 linear feet or less of trench outside of limits of buildings, but no fewer than two tests per trench per day.
 - c. Pond Embankments: At subgrade and at each compacted fill and backfill layer, perform at least one field in-place density test for every 200 linear ft. or less of embankment, but in no case fewer than ten tests. Observe use of impervious fill as embankment materials. Perform evaluation of soils to be used as embankment fill for compliance with material specifications herein.
 - d. Non-Structural Areas: Field density and moisture content tests shall be performed on the fill and backfill at a rate of at least one test per every 15,000 square feet of area being filled.

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3. Building Foundation Excavations: Evaluate bearing subgrades with hand augers and Dynamic Cone Penetrometer (DCP) testing.
 4. Observe proof-rolling as described herein.
 5. Refer to Special Inspections section below for testing within building limits.
- B. When testing agency reports that subgrades, fills, or backfills are below specified density, scarify and moisten or aerate, or remove and replace soil to the depth required, recompact and retest until required density is obtained. Contractor shall be responsible for all costs associated with re-testing required due to failed compaction.
- C. Proofrolling: Subgrade to receive fill, finish subgrade of building or pavement areas, and aggregate base courses shall be proofrolled with a fully loaded dual wheel tandem axle dump truck or similar construction equipment. Four passes shall be made in each orthogonal direction. The proofrolling operation shall be observed by the Owner's testing agency. Should any area fail to tighten up after proofrolling and continue to rut and/or pump, the soil shall be scarified and moistened or aerated and recompact. Repeat proofrolling operations.
1. Proofrolling in confined areas inaccessible to dump trucks shall be performed by other means as determined appropriate by the Owner's independent testing agency.

3.20 SPECIAL INSPECTIONS

- A. Allow Special Inspections and tests to be performed by the Special Inspector or Special Inspection Agency.
- B. Verification and inspection of earthwork construction shall be in accordance with the applicable sections of the current North Carolina State Building Code, and as follows:
1. Review laboratory test reports, certificates of compliance, or other data submitted to show compliance with specifications, and conduct field inspections and tests during earthwork operations as necessary to verify compliance with the contract documents.
 2. All site stripping and proofrolling operations shall be observed and monitored. Verify suitability of subgrade prior to installation of fill.
 3. At footing subgrades, test each soil stratum to verify design bearing capacities. Verification and approval of footing subgrades may be based on a comparison of subgrade with test data. Perform additional testing as necessary.
 4. Test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
 - a. Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. or less of building slab, but in no case fewer than three tests.
 - b. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 50 feet or less of wall length, but no fewer than two tests.
 - c. Trench Backfill in Building Areas: At each compacted initial and final backfill layer, at least one test for every 50 feet or less of trench length, but no fewer than two tests.

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- C. Allow Special Inspector to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements
- D. When subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.
- E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- F. Additional testing performed to determine compliance of corrected work with specified requirements shall be at Contractor's expense.

3.21 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and re-establish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace material to depth directed by the Architect or Owner's independent testing agency; reshape and recompact at optimum moisture content to the required density.
- C. Settling: Where settling occurs during the Project correction period, remove finished surfacing, backfill with additional approved material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.22 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off the Owner's property.

END OF SECTION 312000

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SECTION 312500 - EROSION & SEDIMENT CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following: Soil erosion and sedimentation control for all areas of the site that are graded or disturbed by any construction operations and elsewhere as indicated on the Drawings or specified herein. Erosion control shall be as specified herein and as may be required by actual conditions and governing authorities.
- B. The Contractor is fully responsible for all applicable permits and approvals for off-site borrow and waste areas.
- C. The Contractor shall have full responsibility for the construction and maintenance of erosion control and sedimentation control facilities as shown on the Drawings and as specified herein. The Contractor shall at all times provide the operation and maintenance necessary to operate the permitted sediment and erosion controls at optimum efficiency.
- D. The Contractor shall provide permanent or temporary ground cover as soon as possible over disturbed areas of the site, and shall provide permanent or temporary ground cover in no more than 14 days after construction activities have permanently or temporarily ceased over the disturbed area. Temporary or permanent ground cover shall be provided on slopes within 7 days after construction activities have permanently or temporarily ceased.
- E. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 31 Section "Site Clearing"
 - 2. Division 31 Section "Earth Moving"
 - 3. Division 32 Section "Planting"

1.3 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 01 Specification Sections.
 - 1. Silt fence fabric, wire support and posts.
 - 2. Tree protection fence, signs and posts.
 - 3. Filter fabric.
 - 4. Channel and slope matting.
 - 5. Compost filter socks.
 - 6. Manufactured inlet sediment control devices.
 - 7. Dewatering silt bags.
 - 8. Polyacrylamide (PAM) turbidity control logs.

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1.4 PRODUCT HANDLING

- A. Deliver seed, fertilizer and other packaged materials in unopened original packages with labels legible and intact. Seed packages shall bear a guaranteed analysis by a recognized authority.
- B. On-site storage of materials shall be kept to a minimum. Wet or damaged seed or other material shall be removed from the project site immediately.

1.5 MONITORING AND RECORD KEEPING

- A. Contractor shall abide by all conditions of the General Permit to Discharge Stormwater under the National Pollutant Discharge Elimination System (NPDES), Permit No. NCG010000 (obtain copy from Owner) and the general requirements listed below. NPDES General Permit No. NCG01000 can be viewed at:
[https://files.nc.gov/ncdeq/Energy%20Mineral%20and%20Land%20Resources/Stormwater/NC G010000_Final_Permit_2019_04_01.pdf](https://files.nc.gov/ncdeq/Energy%20Mineral%20and%20Land%20Resources/Stormwater/NC%20G010000_Final_Permit_2019_04_01.pdf)
- B. All sediment and erosion control devices and facilities shall be inspected at least once every seven (7) calendar days and within 24 hours after any storm event of greater than 0.5 inches of rain per 24 hour period.
- C. Stormwater discharges shall be inspected by observation for stormwater discharge characteristics (as listed below) at the above frequency to evaluate the effectiveness of the sediment control facilities, devices or practices. Observations shall be made at all stormwater discharge outfalls and other locations where concentrated stormwater discharges from the site. Observations shall be qualitative, no analytical testing or sampling is required. If any visible off-site sedimentation is leaving the site, corrective action shall be taken to reduce the discharge of sediments.
 - 1. Color.
 - 2. Odor.
 - 3. Clarity.
 - 4. Floating solids.
 - 5. Suspended solids.
 - 6. Foam.
 - 7. Oil sheen.
 - 8. Other obvious indicators of stormwater pollution.
- D. The contractor shall perform and keep records of the above inspections. Visible sedimentation found off the site shall be recorded with a brief explanation as the measures taken to prevent future releases as well as any measures taken to clean up the sediment that has left the site. This record shall be made available to the Owner, Architect and governmental authorities.

PART 2 - PRODUCTS

2.1 SOIL AMENDMENTS AND SEED

- A. Refer to Division 32 Section "Planting".

2.2 MISCELLANEOUS

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- A. Gravel for Stone Filters: Washed No. 57 stone or as indicated on the drawings.
- B. Silt Fence Fabric: A synthetic filter fabric or a pervious sheet of polypropylene, nylon, polyester, or polyethylene yarn, which is certified by the manufacturer or supplier as conforming to the following requirements.
 - 1. Tensile Strength (Grab): 90 x 90-lbs. min., ASTM D 4632.
 - 2. Permittivity: 0.05-sec^{-1} min., ASTM D 4491.
 - 3. Apparent Opening Size: #30 US Sieve (0.60-mm) max., ASTM D 4751.
 - 4. UV Resistance (500-hrs): 70%, ASTM D 4355.
- C. Filter Fabric (for installation under riprap): Woven geotextile fabric, apparent opening size no larger than US Standard Sieve no. 70, min. grab strength of 120-lbs.
- D. Polyacrylamide (PAM) Turbidity Control Log: Soil specific tailored, solid form PAM product containing blends of water treatment components and polyacrylamide co-polymer for water clarification (25 NTU max. at outlet of sediment basin) and erosion control. Product shall be designed for site specific soil and water conditions. APS-700 Series Floc Log by Applied Polymer Systems, Inc. or approved equal.
- E. Dewatering Silt Bag: Permeable, non-woven geotextile bag manufactured to accept and filter pumped, sediment-laden water from dewatering activities. Silt bag shall be sized as appropriate for the dewatering pump discharge rate and shall be fitted with a fill spout large enough to accommodate the discharge piping of the dewatering pump. Silt bag shall be Dirtbag as manufactured by ACF Environmental, Inc. or approved equal.
- F. Compost Filter Sock: Three-dimensional tubular sediment control device comprised of an organic compost filter media contained in a tubular knitted mesh sock.
 - 1. Filter media shall be mature compost that has been certified by the US Composting Council's Seal of Testing Assurance Program and meeting the following specifications.
 - a. pH: 5.0 – 8.5.
 - b. Moisture Content: < 60%.
 - c. Organic Matter: >25%, dry weight.
 - d. Particle Size: 99% passing 2-in sieve, 30-50% passing 3/8-in sieve.
 - 2. Filter sock netting shall be 5-mm thick continuous HDPE filament, tubular knitted mesh with 3/8-in openings. Filled sock shall be a minimum of 12-in in diameter.
 - 3. Stakes shall be 2x2-in x 3-ft wooden stakes.

2.3 INLET PROTECTION MEASURES

- A. Manufactured Inlet Sediment Control Device: Storm drainage inlet sediment control device shall be manufactured from woven polypropylene geotextile to fit the opening of a catch basin or drop inlet to filter sediment from runoff entering the inlet. The device shall be a High Flow Siltsack as manufactured by ACF Environmental, Inc. or approved equal. Device shall be provided with an integral curb deflector if installed at a catch basin with a vertical opening adjacent to a horizontal grate.

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- B. Floor Drain / Area Drain Sediment Filter Device: Small size storm drainage inlet sediment control device shall be manufactured from woven polypropylene geotextile to fit into small diameter floor drains to filter sediment from runoff entering the inlet. The device shall be a Round Drain Insert as manufactured by New Pig Corp. or approved equal.

2.4 CHANNEL AND SLOPE MATTING

- A. Channel Matting: Erosion Control blankets for installation in channels shall be a machine-produced mat of curled wood fiber (excelsior) or synthetic polypropylene fiber as specified below. The blanket shall be of consistent thickness with the fiber evenly distributed over the entire area of the mat. The blanket shall be covered with a photo degradable plastic netting secured to the fiber mat. Channel liners shall be excelsior mat unless otherwise indicated on the drawings.
1. Excelsior Mat:
 - a. Fiber: Curled wood excelsior of 80% six inch or longer fiber length with a consistent width of fibers evenly distributed throughout the mat. Mat shall be smolder resistant with no chemical additives.
 - b. Top and Bottom Netting: Photo degradable extruded plastic netting with maximum mesh size of $\frac{3}{4}$ " x $\frac{3}{4}$ ".
 2. Coconut Mat:
 - a. Fiber: 100% coconut fiber (0.5-lbs./sq.yd.)
 - b. Top Netting: 100% biodegradable jute (9.3-lbs/1000-sq.ft. approx. weight.)
 - c. Bottom Netting: 100% biodegradable jute (7.7-lbs/1000-sq.ft. approx. weight.)
 - d. C125BN by North American Green or approved equal.
 3. Synthetic Mat (Polypropylene):
 - a. Fiber: 100% UV stabilized polypropylene fiber matrix (0.5-lbs./sq.yd.)
 - b. Top and Bottom Netting: UV stabilized polypropylene (24-lbs/1000-sq.ft. approx. weight.)
 - c. Middle Netting: Corrugated UV stabilized polypropylene (24-lbs/1000-sq.ft. approx. weight.)
 - d. P550 by North American Green or approved equal.
 4. Straw/Coconut Mat:
 - a. Fiber: 70% Straw fiber matrix (0.35-lbs./sq.yd.), 30% Coconut fiber matrix (0.15-lbs./sq.yd.)
 - b. Top and Bottom Netting: UV stabilized polypropylene (5-lbs/1000-sq.ft. approx. weight.)
 - c. Middle Netting: Corrugated UV stabilized polypropylene (24-lbs/1000-sq.ft. approx. weight.)
 - d. SC250 by North American Green or approved equal.
 5. Wire Staples: 16 gauge steel wire, with minimum of 3" top and 6" long legs. 1.75 staples per square yard of matting minimum.

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- B. Slope Matting: Erosion Control blankets for installation on slopes (not channels) shall be a machine-produced mat of crimped wood fiber and/or other degradable fibers manufactured without nets or threads. Staples or stakes used to secure the mat shall be wood or 100% biodegradable natural material. No nets or metal staples shall be used on any areas other than within channels.

1. Excelsior Mat:

- a. Fiber: Net-free, curled wood excelsior of 80% six inch or longer fiber length with a consistent width of fibers evenly distributed throughout the mat. Mat shall be smolder resistant with no chemical additives.

2. Stakes or Staples: Wood or 100% biodegradable natural material with additive to cause breakdown and 100% degradation within 24-36 months after installation.

2.5 RIPRAP

- A. Riprap: Provide riprap of the class and quantity indicated on the Drawings. While no specific gradation is required, the various sizes of the stone shall be equally distributed within the required size range. The size of an individual stone shall be determined by measuring its long dimension. Stone shall meet the requirements of the following table for class and size distribution. No more than 5% of the material furnished can be less than the minimum size specified nor no more than 10% of the material can exceed the maximum size specified.

REQUIRED STONE SIZES - INCHES			
CLASS	MINIMUM	MIDRANGE	MAXIMUM
A	2	4	6
B	5	8	12
1	5	10	17
2	9	14	23

PART 3 - EXECUTION

3.1 GENERAL

A. Existing Structures and Facilities

- Existing structures, facilities, and water courses shall be protected from sedimentation.
- The Contractor shall be responsible for the construction of necessary measures, and all costs shall be at the expense of the Contractor.
- Items to be protected from sedimentation deposits shall include, but are not limited to, all downstream property, natural waterways, streams, lakes and ponds, catch basins, drainage ditches, road gutters, and natural buffer zones.
- Control measures such as the erection of silt fences, barriers, dams, or other structures shall begin prior to any land disturbing activity. Additional measures shall be constructed as required during the construction.
- All facilities installed shall be maintained continuously during construction until the disturbed areas are stabilized. Contractor shall remove all erosion control measures at the

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end of the project at his expense unless otherwise directed by the Owner or his representative.

6. Perform monitoring and record keeping as specified in this section.

3.2 PROTECTIVE MEASURES

- A. Protective measures shall conform to all State and Local requirements.
- B. Construction and maintenance of sediment and erosion control measures shall be in accordance with all applicable laws, codes, ordinances, rules and regulations.
 1. Silt Fence: Hog wire or wire mesh fastened to posts as recommended by the Manufacturer and covered with silt fabric.
 2. Berms and Diversion Ditches: These shall be graded channels with a supporting ridge on the lower side constructed across a sloping land surface. Diversion ditches and berms shall be planted in vegetative cover as soon as completed.
 3. Mulching: Mulching shall be used to prevent erosion and to hold soil and seed in place during the establishment of vegetation.
 4. **Matting: Temporary slope and channel matting shall be used for temporary stabilization during the establishment of seeded cover in all grassed ditches, channels, long slopes, and steep banks (6:1 or steeper) and additional areas as indicated on plans.** Matting shall be installed on any area on site as needed to provide temporary stabilization whether or not matting is indicated on the plan. Install as indicated or per manufacturer's instructions. The installation of matting may be waived by the Architect if surface stabilization is obtained by other methods within the appropriate and agreed time frames. If adequate stabilization is not obtained, the Contractor shall install matting where required at no additional cost to the Owner.
 5. Build Berm, Pits and Gravel Filter as shown on Drawings. Maintain during construction to keep erosion and sedimentation to a minimum. When it is necessary to remove berm, pits, and gravel, return area to required profiles and condition.
 6. Construction Entrances: Construct all entrances in accordance with plans. Maintain all ingress/egress points to prevent tracking of soil onto the Owner's, public or private roads. Any soil that is tracked onto the roads shall be removed immediately.
 7. Riprap: Stone shall be graded so that the smaller stones are uniformly distributed throughout the mass. Stone may be placed by mechanical methods, augmented by hand placing where necessary, provided that when the riprap is completed it forms a properly graded, dense, neat layer of stone.
 8. Manufactured Inlet Sediment Control Device: Install device in accordance with manufacturer's instructions and install a curb deflector if appropriate. Inspect device after each rain event and at intervals not exceeding two weeks during construction. Remove, empty, clean, and replace the device as needed during construction. Empty collected sediment in approved, protected location. Remove and dispose of device following full and permanent stabilization of the contributing drainage area.
 9. PAM Turbidity Logs: At a minimum, install logs in drainage structures located immediately upstream of sediment basins and traps. Install additional logs in any other locations indicated on the drawings. Install per manufacturer's instructions. Check logs regularly and after every runoff producing rainfall and replace as needed throughout the duration of construction.
 10. Dewatering Silt Bag: Install silt bag on an undisturbed slope so incoming water flows downhill through the bag without causing erosion. Remove and replace silt bag when

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device no longer drains efficiently due to accumulated sediment in bag. Empty bag within disturbed limits of the site protected by other sediment control measures.

11. Compost Filter Logs: Stake filter log every 10-ft. Drive stakes through the center of the log and 1-ft into the ground. If sock netting must be joined, fit beginning of the new sock over the end of the old sock, overlapping by 1-2 ft. Fill with compost and stake the joint.
12. Other Measures: Other methods of protecting existing structures and facilities, such as vegetative filter strips, diversions, rip-rap, baffle boards, and ditch checks used for reduction of sediment movement and erosion, may be used at the option of the Contractor when approved by the appropriate State or local authorities.

C. Provide the following, at a minimum, to prevent windblown dust.

1. Apply straw mulch and establish temporary or permanent ground cover on exposed soil where work is not being actively performed.
2. Cover or establish vegetative cover on stockpiles.
3. Apply water or other approved dust suppressant as needed to soil surfaces before they become excessively dry.
4. Sweep and collect soil that has been tracked onto paved surfaces.

3.3 STABILIZATION

- A. Permanently protect stabilized areas prior to the removal of protective devices.
- B. After the final establishment of permanent stabilization, remove temporary sediment control measures. Re-spread accumulated sediments as specified.
- C. Permanently stabilize all areas disturbed by the removal and re-spreading operations immediately.

3.4 TEMPORARY SEEDING

- A. In accordance with the schedule as detailed on the drawings.

3.5 PERMANENT SEEDING

- A. In accordance with the schedule as detailed on the drawings.

3.6 MULCHING AND MATTING

- A. Apply mulch or matting to retain soil and grass.
- B. Mulch areas with slope greater than 5% by spreading a light cover of mulch over seeded area at the rate of not less than 85 lbs. per 1000 sq. ft.
- C. Install temporary matting in all grassed ditches, channels, long slopes, and steep banks (6:1 or steeper) and additional areas indicated on plans or where extra protection from erosion is needed.

END OF SECTION 312500

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SECTION 321216 - ASPHALT PAVING

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 this Section.

1.2 SUMMARY

- A. This Section includes provisions for hot-mixed asphalt paving over prepared subbase.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Material Certificates signed by material producer and Contractor, certifying that each material item complies with or exceeds specified requirements of NCDOT "Standard Specifications for Roads and Structures".
- C. Job Mix Formula: Provide Geotechnical consultant with two copies of the proposed job mix formula at least ten days prior to beginning work. This formula shall be approved by NCDOT for the type of pavement specified.
- D. Recycled Content: 15% minimum, or as approved by NCDOT except as noted below.

1.4 SITE CONDITIONS

- A. Weather Limitations for Prime and Tack Coats: Apply prime and tack coats only when the surface to be treated is dry and when the atmospheric temperature measured at the location of paving operations away from artificial heat are in compliance with current NCDOT Standard Specifications for Roads and Structures. Do not apply tack coat when weather is foggy or rainy.
- B. Weather Limitations for Asphalt Courses: Apply hot-mixed asphalt surface, intermediate and base courses when surface and air temperatures are in compliance with current NCDOT Standard Specifications for Roads and Structures and when base is dry.
- C. Grade Control: Establish and maintain required lines and elevations.
- D. Traffic Control: Provide traffic control devices, lane closures, positive protection and/or any other warning or positive protection devices necessary for the safety of road users and pedestrians during construction.
 - 1. Traffic control shall be performed in conformance with the latest NCDOT Roadway Standard Drawings and Standard Specifications for Roads and Structures and the Manual on Uniform Traffic Control Devices for Streets and Highways.

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2. Sidewalk closures shall be installed as necessary. Pedestrian traffic shall be detoured around these closures and shall be signed appropriately and in accordance with ADA guidelines.
3. Two-way traffic shall be maintained at all times through use of flagmen when necessary.
4. Maintain access for fire-fighting equipment and access to fire hydrants.

1.5 QUALITY ASSURANCE

- A. All materials, construction methods and testing shall comply with the requirements of the latest editions of the North Carolina Department of Transportation (NCDOT) "Standard Specifications for Roads and Structures" and the Asphalt Handbook Manual Series No. 4 (MS-4).
- B. All work within any NCDOT right-of-way shall conform to the provisions and conditions of the NCDOT encroachment agreement(s) and driveway permit(s) and other applicable NCDOT standards and policies. The encroachment agreement(s) and driveway permit(s) are considered part of the project specifications by reference. Copies of the agreement(s) and permit(s) will be provided upon request from the Architect.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Use locally available materials and gradations that comply with the requirements of the NCDOT "Standard Specifications for Roads and Structures" and exhibit a satisfactory record of previous installations.
- B. Aggregate Base Course (ABC): Type A aggregate base course meeting the requirements of the latest version of NCDOT "Standard Specifications for Roads and Structures."
- C. Superpave Asphalt Paving Mix: Superpave base, intermediate and surface asphalt paving mix meeting the requirements of the latest version of NCDOT "Standard Specifications for Roads and Structures." Types as indicated on the drawings.
- D. Tack Coat: Asphalt material meeting the requirement of the latest version of NCDOT "Standard Specifications for Roads and Structures."
- E. Parking Lot Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II, with drying time of less than 45 minutes.
 1. Color: White for parking lot striping.
 2. Color: Yellow for fire lanes and service area striping.
- F. Roadway Pavement Marking Paint: Thermoplastic Alkyd/Maleic and Hydrocarbon type, meeting the requirements of Section 1087 of NCDOT "Standard Specifications for Roads and Structures."
 1. Color: As indicated on the drawings.

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- G. Seal Coat Surface Treatment: Sand seal shall be comprised of the application of an asphalt emulsion followed by and sand aggregate cover over existing asphalt pavement.
1. Asphalt Emulsion: Grade CRS-2 or CRS-2P conforming to NCDOT Standard 1020-7 as compatible with specified aggregate.
 2. Aggregate: Clean sand free from clay or organic material, suitable for the purpose of sand seals. Grain Size Distribution (ASTM C136-95A):

<u>Sieve Size</u>	<u>Percent Passing</u>
3/8"	100
#4	95-100
#8	85-97
#16	60-80
#30	10-20
#50	5-15
#100	0-5

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

- A. General: Remove loose material from compacted subbase surface immediately before applying base courses of asphalt.
- B. Proof-roll prepared subgrade surface as described in Section "Earth Moving" to check for unstable areas and areas requiring additional compaction.
- C. Do not begin paving work until deficient subbase areas have been corrected and are ready to receive paving. Ensure subgrade is graded for proper drainage. Repair as needed to avoid ponding on final pavement surfaces.
- D. Cold mill surfaces of existing pavements in locations and to depths as indicated on the drawings and as follows.
 1. At edges of existing pavement to be overlaid: Cold mill surfaces of existing pavements to a minimum depth of 1.5-inches at longitudinal terminus of asphalt overlays for a minimum width of 10 feet (extend terminus milling width to 100-ft on public roads) and at horizontal terminus (including along gutter line of existing curbs adjacent to asphalt overlays) for a minimum width of 6 feet to allow a smooth transition from full-depth thickness of overlay course to existing pavement or gutter surface. Thoroughly remove all loose material from milled surface before placing tack coat.
 2. At pavement to be wedge overlaid: Cold mill surfaces of existing pavements to required depths at edges of asphalt wedge sections on public roads for widths needed to allow minimum depth thickness of wedge course. Thoroughly remove all loose material from milled surface before placing tack coat.
 3. At butt joint of new asphalt to existing asphalt: Cold mill surfaces of existing pavements to a minimum depth of 1.5-inches for a minimum width of 18-inches along length of new joint to allow new asphalt surface to be keyed-in to the existing pavement. Thoroughly remove all loose material from milled surface before placing tack coat.

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- E. Thoroughly remove all dust and loose material from surfaces of that which the tack coat is to be applied along with adjacent surfaces before placing tack coat.
- F. Crack Filling: Remove debris from cracks or joints to a depth of 1/4 inch.
 - 1. Clean cracks and joints in existing asphalt pavement with compressed air.
 - 2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.
 - 3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.
- G. Apply tack coat to all contact surfaces of milled asphalt, existing asphalt to be overlaid, and surfaces abutting or projecting into hot-mixed asphalt pavement including the vertical face of adjacent concrete gutter. Distribute evenly and thoroughly at a rate of 0.04 to 0.08 gallons per sq. yd. of surface.
 - 1. Apply only as much tack coat as can be covered during the same day's operation.
 - 2. Take necessary precautions to limit the tracking and/or accumulation of tack coat material on either existing or newly constructed pavements. Excessive accumulation of tack may require corrective measures.
 - 3. Apply tack coat material with a distributor spray bar that can be adjusted to uniformly coat the entire surface at the directed rate. Use hand hose attachments only on irregular area and areas inaccessible to the spray bar. Cover these areas uniformly and completely.
 - 4. Apply tack coat to contact surfaces of gutters, concrete pavements, manholes, vertical faces of old pavements, and all exposed transverse and longitudinal edges of each course before mixture is placed adjacent to such surfaces.
 - 5. Cover curbs, adjacent concrete, and all other appurtenances to protect them from tracking or splattering tack coat material.
 - 6. Do not place any asphalt mixture until the tack coat has sufficiently cured.
- H. Allow to dry until at proper condition to receive paving.
- I. Exercise care in applying bituminous materials to avoid smearing of adjoining concrete surfaces. Remove and clean damaged surfaces.
- J. Place aggregate base courses as specified in Section "Earth Moving".

3.2 PATCHING

- A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.
- B. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd.
 - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

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- C. Patching: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.3 REPAIRS

- A. Patching: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Re-compact existing unbound-aggregate base course to form new subgrade. Install hot-mix asphalt pavement per the requirements of this section.
- B. Crack Filling: Remove debris from cracks or joints to a depth of 1/4 inch.
 - 1. Clean cracks and joints in existing hot-mix asphalt pavement.
 - 2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.
 - 3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

3.4 PLACING MIX

- A. Limitations: Do not produce or place asphalt mixtures during rainy weather, when the subgrade or base course is frozen, or when the moisture on the surface to be paved would prevent proper bond. Comply with all NCDOT weather and temperature limitations.
- B. General: Place hot-mixed asphalt mixture on prepared surface, spread, and strike off. Spread mixture at minimum temperature of 225 deg F. Place areas inaccessible to equipment by hand. Place each course to required grade, cross-section, and compacted thickness.
- C. Paver Placing: Place in strips not less than 10 feet wide, unless otherwise acceptable to Architect. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete base course for a section before placing surface course.
- D. Immediately correct surface irregularities in finish course behind paver. Remove excess material forming high spots with shovel or lute.
- E. Joints: Make joints between old and new pavements, or between successive days' work, to ensure continuous bond between adjoining work. Construct joints to have same texture, density, and smoothness as other sections of hot-mixed asphalt course. Clean contact surfaces and apply tack coat.

3.5 ROLLING

- A. General: Begin rolling when mixture will bear roller weight without excessive displacement.
- B. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.

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- C. Breakdown Rolling: Accomplish breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling and repair displaced areas by loosening and filling, if required, with hot material.
- D. Second Rolling: Follow breakdown rolling as soon as possible, while mixture is hot. Continue second rolling until mixture has been evenly compacted.
- E. Finish Rolling: Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has attained required density. Compact the asphalt to at least the minimum percentage of the maximum specific gravity listed below unless otherwise allowed by NCDOT.
 - 1. SF-9.5A: 90.0% of Maximum Specific Gravity
 - 2. S-9.5B/C, I-19.0B/C, B-25.0B/C: 92.0% of Maximum Specific Gravity.
- F. Patching: Remove and replace paving areas mixed with foreign materials and defective areas. Cut out such areas and fill with fresh, hot hot-mixed asphalt. Compact by rolling to specified surface density and smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.6 SEALCOATING OF EXISTING ASPHALT PAVEMENT

- A. Preparation: Existing pavement surfaces shall be cleaned of all dust and dirt and any loose materials. Apply asphalt material only when the surface to be treated is dry and when the atmospheric temperature is above 60-deg F in the shade. Do not apply asphalt material in fog or rain weather conditions.
- B. Apply approximately 0.35-0.40 gal. per sq.yd. of asphalt material to the existing surface immediately followed by the application of 30-35 lbs. per sq.yd. of sand aggregate. Uniformly spread the full required amount of sand in one application and correct all non-uniform areas prior to rolling. Contractor may mix asphalt emulsion and sand aggregate prior to application of sand seal surface treatment.
- C. Immediately after the sand has been uniformly spread, perform rolling with pneumatic tired rollers until the aggregate is thoroughly keyed into the liquid asphalt. Use rollers designed to prevent picking up the material.

3.7 TRAFFIC MARKINGS

- A. Cleaning: Sweep and clean surface to eliminate loose material and dust.
- B. Materials: Use thermoplastic marking for permanent markings on public streets and stop bars and crosswalks on private drives and parking lots. Use marking paint for parking and fire lane striping and other markings on private drives and parking lots.

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- C. Apply traffic paint with mechanical equipment to produce uniform straight edges. Apply at manufacturer's recommended rates to provide minimum 12 to 15 mils dry thickness.
- D. Apply thermoplastic markings using application equipment constructed to assure continuous uniformity in the thickness and width of the thermoplastic pavement marking. Use equipment that provides multiple width settings ranging from 4 inches to 12 inches and multiple thickness settings to achieve the pavement marking thickness ranging from 0.090 inch to 0.120 inch. Comply with all applicable NCDOT standards.
- E. Remove existing markings as indicated by water blasting.

3.8 FIELD QUALITY CONTROL

- A. General: Testing of asphalt concrete mix and in-place hot-mixed asphalt courses for compliance with requirements for thickness and surface smoothness will be done by Owner's testing laboratory in accordance with Division 1 Section "Quality Control." Repair or remove and replace unacceptable paving as directed by Architect.
 - 1. Owner's Independent Testing Agency will conduct and interpret tests and state in each report whether tested work complies with or deviates from the specified requirements.
- B. Thickness: In-place compacted thickness of each layer of asphalt shall be tested in accordance with ASTM D 3549. Results shall be considered unacceptable if the compacted thickness of any one core sample is greater than 1/2-inch below the thickness specified on the drawings or if the average thickness of all core samples is less than the thickness specified on the drawings.
- C. Surface Smoothness: Test finished surface of each hot-mixed asphalt course for smoothness, using 10 feet straightedge applied parallel with and at right angles to centerline of paved area. Surfaces will not be acceptable if exceeding the following tolerances for smoothness:
 - 1. Base Course Surface: 1/4 inch.
 - 2. Wearing Course Surface: 3/16 inch.
 - 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.
- D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979 or AASHTO T 168.
 - 1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
 - 2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.
 - a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.
 - b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.

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- E. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.
- F. Contractor shall repair all test core holes with full depth asphalt patch.
- G. Perform ponding water tests. Repair areas of pavement that pond water.
- H. Check surface areas at intervals as directed by Architect.

END OF SECTION 321216

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SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes exterior portland cement concrete paving for the following:
 - 1. Curbs and gutters, pavement, walkways, service court, dumpster pads.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 31 Section "Earth Moving" for subgrade preparation, grading and subbase course.
 - 2. Division 03 Section "Cast-in-Place Concrete" for general building applications of concrete.
 - 3. Division 07 Section "Sealants and Caulking" for joint fillers and sealants within concrete paving and at joints with adjacent construction.

1.3 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 01 Specification Sections.
- B. Product data for proprietary materials and items, including reinforcement and forming accessories, admixtures, joint systems, curing compounds, dry-shake finish materials, and others if requested by Architect.
- C. Design mixes for each class of concrete. Include percentage of recycled content (20% minimum). Include revised mix proportions when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
- D. Scaled plan of proposed construction, expansion and control joint locations in concrete pavement and concrete sidewalk. Submittal of plans for joints in curb and gutter or longitudinal sidewalk 6-feet or less in width is not required.

1.4 QUALITY ASSURANCE

- A. Concrete Standards: Comply with provisions of the following standards, except where more stringent requirements are indicated.
 - 1. American Concrete Institute (ACI) 301, "Specifications for Structural Concrete for Buildings."
 - 2. ACI 318, "Building Code Requirements for Reinforced Concrete."
 - 3. ACI 330R, "Guide for the Design and Construction of Concrete Parking Lots."

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4. Concrete Reinforcing Steel Institute (CRSI) "Manual of Standard Practice."
- B. Concrete Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
- C. Concrete Testing Service: Engage a qualified independent testing agency to perform materials evaluation tests and to design concrete mixes.
- D. All work within any NCDOT right-of-way shall conform to the requirements of the current version of the NCDOT's Policies and Procedures for Accommodating Utilities on Highway Rights of Way, the provisions and conditions of the encroachment agreement(s), and other applicable NCDOT standards and policies. The encroachment agreement(s) are considered part of the project specifications by reference. Copies of the agreement(s) will be provided upon request from the Architect.

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 Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
 2. 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 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.
 1. Use flexible or curved forms for curves with a radius 100 feet or less.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

- A. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
- B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.
- C. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60, deformed bars; assembled with clips.
- D. Plain Steel Wire: ASTM A 82, as drawn.

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- E. Joint Dowel Bars: Plain steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs. Electroplated zinc, tapered steel plates, ASTM A 108, ASTM B633 with corresponding pocket former are an acceptable alternative to dowel bars.
 - 1. Unless indicated otherwise on the drawings, dowels shall be the following diameter:
 - a. 6-in slabs: 5/8-in diameter dowels.
 - b. 7-in slabs: 1-in diameter dowels.
 - c. 8-in or thicker slabs: 1-1/4-in diameter dowels.
- F. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.
- G. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete, and as follows:
 - 1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use one of the following cementitious materials, of the same type, brand, and source throughout the Project:
 - 1. Portland Cement: ASTM C 150, portland cement, Type I, II, or III.
 - a. Fly Ash: ASTM C 618, Class F. Up to 30% by weight of required cement content, with 1.0-lbs Fly Ash per 1-lb of cement replaced.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120 with 1-lb slag per 1-lb of cement replaced.
- B. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate, uniformly graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar pavement applications and service conditions using similar aggregates and cementitious materials.
 - 1. Maximum Coarse-Aggregate Size: 1-1/2 inches nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94/C 94M, potable.
- D. Air-Entraining Admixture: ASTM C 260.
- E. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.

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3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.5 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.
- E. Clear Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

2.6 RELATED MATERIALS

- A. Expansion and Isolation Joint Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Wheel Stops: Precast, air-entrained concrete; 2500-psi minimum compressive strength; approximately 6 inches high, 9 inches wide, and 84 inches long. Provide chamfered corners and drainage slots on underside and provide holes for dowel-anchoring to substrate.
 1. Dowels: Galvanized steel, diameter of $\frac{3}{4}$ inch, minimum length 10 inches.
- C. Slip Resistive Aggregate Finish: Factory-graded, packaged, rustproof, non-glazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 25 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.
- D. Bonding Agent: ASTM C 1059, Acrylic or styrene butadiene.
- E. Epoxy Adhesive: ASTM C 881, two-component material suitable for dry or damp surfaces. Provide material type, grade, and class to suit requirements.

2.7 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.
 1. Use a qualified independent testing agency for preparing and reporting proposed concrete mixture designs for the trial batch method.
- B. Proportion mixtures to provide normal-weight concrete with the following properties:

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1. Compressive Strength (28 Days): 4,500-psi, 4000 psi, 3500 psi, or 3000 psi as indicated on the drawings.
 2. Maximum Water-Cementitious Materials Ratio at Point of Placement: As specified by NCDOT Standard Specifications for class of concrete indicated.
 3. Slump Limit: Maximum 3.5 inches for non-vibrated, maximum 4 inches for vibrated.
- C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
1. Air Content: 5-1/2 percent plus or minus 1.5 percent for 1-1/2-inch (38-mm) nominal maximum aggregate size.
 2. Air Content: 6 percent plus or minus 1.5 percent for 1-inch (25-mm) nominal maximum aggregate size.
 3. Air Content: 6 percent plus or minus 1.5 percent for 3/4-inch (19-mm) nominal maximum aggregate size.
- D. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use admixtures in concrete, as required, for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
- E. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements as follows:
1. Fly Ash: 30 percent.
 2. Ground Granulated Blast-Furnace Slag: 50 percent.
 3. Combined Fly Ash, and Ground Granulated Blast-Furnace Slag: 50 percent, with fly ash not exceeding 20 percent.
- F. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.8 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C 1116. Furnish batch certificates for each batch discharged and used in the Work.
1. When air temperature is between 85 deg F and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
1. For concrete mixes of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 2. For concrete mixes larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.

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3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

2.9 JOINT SEALANTS

- A. Type SL Silicone Sealant for Concrete and Asphalt: Single-component, low modulus, neutral-curing, self-leveling silicone sealant complying with ASTM D 5893 for Type SL.
- B. Round Backer Rod for Cold-Applied Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depths and pavement bottom-side adhesion of sealant.

2.10 PAVEMENT MARKINGS

- A. Parking Lot Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II, with drying time of less than 45 minutes and formulated for concrete surfaces.
 1. Color: As indicated on the drawings.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

- A. Proof-roll prepared subbase surface to check for unstable areas and verify need for additional compaction. Do not begin paving work until such conditions have been corrected and are ready to receive paving. Ensure subgrade is graded for proper drainage. Repair as needed to avoid ponding on final pavement surfaces.
- B. Remove loose material from compacted subbase surface immediately before placing concrete.
- C. Herbicide Treatment: Apply chemical weed control agent in strict compliance with manufacturer's recommended dosages and application instructions. Apply to compacted, dry subbase.
- D. Place aggregate base courses as specified in Division 31 Section "Earth Moving".

3.2 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for paving to required lines, grades, and elevations. Install forms to allow continuous progress of work and so that forms can remain in place at least 24 hours after concrete placement. Set forms to ensure positive drainage and compliance with ADA and Building Code requirements.
- B. Check completed formwork and screeds for grade and alignment to following tolerances:
 1. Top of Forms: Not more than 1/8 inch in 10 feet.
 2. Vertical Face on Longitudinal Axis: Not more than 1/4 inch in 10 feet.

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- C. Clean forms after each use and coat with form release agent as required to ensure separation from concrete without damage.

3.3 PLACING REINFORCEMENT

- A. General: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars" for placing and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded wire fabric in lengths as long as practicable at mid depth of concrete. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.4 JOINTS

- A. General: Refer to the project plans and details for additional requirements.
 - 1. Construct contraction, construction, and isolation joints true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to the centerline, unless indicated otherwise.
 - 2. When joining existing paving, place transverse joints to align with previously placed joints, unless indicated otherwise.
- C. Contraction (Control) Joints: Provide weakened-plane contraction joints, sectioning concrete into areas as indicated below unless shown otherwise on Drawings. Construct contraction joints for a depth equal to 1/4 to 1/3 of the concrete thickness, as follows:
 - 1. Tooled Joints: Form contraction joints in fresh concrete by grooving and finishing each edge of joint with a radiused jointer tool.
 - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into hardened concrete when cutting action will not tear, abrade, or otherwise damage surface and before development of random contraction cracks.
 - 3. Inserts: Form contraction joints by inserting premolded plastic, hardboard, or fiberboard strips into fresh concrete until top surface of strip is flush with paving surface. Radius each joint edge with a jointer tool. Carefully remove strips or caps of two-piece assemblies after concrete has hardened. Clean groove of loose debris.
 - 4. Spacing:
 - a. Concrete Pavement (4-in to 4.5-in thick slabs): Locate contraction joints at 10-ft max. intervals, each way in concrete pavement.
 - b. Concrete Pavement (5-in to 5.5-in thick slabs): Locate contraction joints at 12.5-ft max. intervals, each way in concrete pavement.
 - c. Concrete Pavement (6-in and greater thick slabs): Locate contraction joints at 15-ft max. intervals, each way in concrete pavement.
 - d. Sidewalk & Patios (4-in thick slabs): Locate contraction joints at 5-ft max. intervals, each way in concrete sidewalks/patios unless shown otherwise.

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Locate contraction joints in sidewalks less than 8-ft in width at 5-ft intervals across the walk. Locate contraction joints in sidewalks of 8-ft and greater width at 5-ft intervals across the walk and equally section the walk lengthwise with joints at 5-ft. max. intervals (example: an 8-ft wide walk shall have contraction joints at 5-ft. spacing across the walk and one joint dividing the walk lengthwise into two, equal 4-ft sections.)

- e. Curbs or Curb & Gutter: Locate contraction joints at 10-ft max. intervals in concrete curbs or concrete curb and gutter.
5. Dowels: Some concrete pavement applications in very heavy load locations (such as fire stations) require dowels at contraction joints. Refer to the drawings for specific details for such requirements.
- C. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than 1/2 hour, unless paving terminates at isolation joints.
 1. Continue reinforcement across construction joints unless indicated otherwise. Do not continue reinforcement through sides of strip paving unless indicated.
 2. Provide tie bars at sides of paving strips where indicated.
 3. Use bonding agent on existing concrete surfaces that will be joined with fresh concrete.
- D. Isolation (expansion) Joints: Form isolation joints of preformed joint filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
 1. General spacing: Locate additional expansion joints at the following intervals unless indicated otherwise on the drawings.
 - a. Pavement (greater than 4-in thick slabs): None in addition to located specified above.
 - b. Sidewalks (4-in thick slabs): 30-ft each way.
 - c. Curbs or Curb & Gutter: 90-ft spacing.
 2. Extend joint fillers full width and depth of joint 1/2 inch below finished surface where joint sealant is indicated. Place top of joint filler flush with finished concrete surface when no joint sealant is required.
 3. Furnish joint fillers in one-piece lengths for full width being placed wherever possible. Where more than one length is required, lace or clip joint filler sections together.
 4. Protect top edge of joint filler during concrete placement with a metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- E. Dowel Joints: Install dowel sleeves and dowels or dowel bar and support assemblies at joints where indicated.
 1. Use dowel sleeves or lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.
 2. Use pocket formers, installed per manufacturer recommendations, if steel plates are used in-lieu of dowels.

3.5 CONCRETE PLACEMENT

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- A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades to permit installation of their work. Ensure forms are set to ensure water will not pond on final surface.
- B. Remove snow, ice, or frost from base surface and reinforcing before placing concrete. Do not place concrete on surfaces that are frozen.
- C. Moisten base to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.
- D. Comply with requirements and with ACI 304R for measuring, mixing, transporting, and placing concrete.
- E. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- F. Form and pour concrete pavement with thickened edges along all edges that could be subject to vehicle wheel loads, do not abut a building or wall, or are not doweled to the adjacent pavement or structure.
- G. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- H. Consolidate concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures to consolidate concrete complying with ACI 309R.
 - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocating reinforcing, dowels, and joint devices.
- I. Screed paved surfaces with a straightedge and strike off. Use bull floats or darbies to form a smooth surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces prior to beginning finishing operations.
- J. Place concrete in two operations; strike off initial pour for entire width of placement and to the required depth below finish surface. Lay welded wire fabric or fabricated bar mats immediately in final position. Place top layer of concrete, strike off, and screed.
 - 1. Remove and replace portions of bottom layer of concrete that have been placed more than 15 minutes without being covered by top layer or use bonding agent if acceptable to Architect.
- K. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as

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specified for formed concrete. If results are not acceptable, remove and replace with formed concrete.

1. Spill Gutters: Form and install curb and gutter with gutter pans that spill at ¼" per foot slope away from the curb in the following locations. Do not install curb and gutter that will pond water.
 - a. Outside of the Public Right of Way: Provide spill gutter where curb and gutter is located adjacent to pavement surfaces that slope away from curb.
 - b. Within the Public Right of Way: Slope gutter per NCDOT Standard Drawing 846.01.
- L. Cold-Weather Placement: Comply with provisions of ACI 306R and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 1. When air temperature has fallen to or is expected to fall below 40 deg F (4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
 2. Do not use frozen materials or materials containing ice or snow.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.
- M. Hot-Weather Placement: Place concrete complying with ACI 305R and as specified when hot weather conditions exist.
 1. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90 deg F (32 deg C). Mixing water may be chilled or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.
 3. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.6 CONCRETE FINISHING

- A. Float Finish: Begin floating when bleed water sheen has disappeared and the concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Finish surfaces to true planes within a tolerance of 1/4 inch in 10 feet as determined by a 10-foot-long straightedge placed anywhere on the surface in any direction. Cut down high spots and fill low spots to ensure positive drainage and eliminate ponding. Refloat surface immediately to a uniform granular texture.
 1. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across all site concrete sidewalk and pavement surfaces perpendicular to line of traffic to provide a uniform fine line texture finish.

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- B. Final Tooling: Tool edges of paving, gutters, curbs, and joints formed in fresh concrete with a jointing tool to a radius of ¼-inch unless indicated otherwise on the drawings. Repeat tooling of edges and joints after applying surface finishes. Eliminate tool marks on concrete surfaces.
- C. Step Tread Grooves: Tool three (3) parallel grooves along entire top front edge of new concrete stair treads.

3.7 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with the recommendations of ACI 306R for cold weather protection and ACI 305R for hot weather protection during curing.
- B. Evaporation Control: In hot, dry, and windy weather, protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material. Apply according to manufacturer's instructions after screeding and bull floating, but before floating.
- C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- D. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than 7 days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with a 12-inch lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.8 TRAFFIC MARKINGS

- A. Cleaning: Remove all oil, dust, grease, dirt, loose rust, and other foreign material to ensure adequate adhesion.
- B. Surface Preparation: Surfaces shall be cured, clean, dry and sound. Remove all peeling paint from existing surfaces. Concrete surfaces shall cure minimum 30 days. Concrete sealers or

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efflorescence of new concrete should be removed by extended weathering, etching or abrasive blasting.

- C. Application Conditions: 50° min., 90° maximum (air, surface, and materials) at least 5° above dew point. Relative humidity 85% maximum.
- D. Tinting: Mix colors per manufacturer's specification. Only mix like paints (do not mix latex with acrylic or interior paints with exterior paints) to achieve required colors.
- E. Apply traffic paint with mechanical equipment to produce uniform straight edges. Apply at manufacturer's recommended rates to provide minimum 12 to 15 mils dry thickness.

3.9 FIELD QUALITY CONTROL TESTING

- A. The Owner shall employ an independent testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement in accordance with Division 01 Section "Quality Control" and as follows:
 - 1. When total quantity of a given class of concrete is less than 50 cu. yd., Architect may waive strength testing if adequate evidence of satisfactory strength is provided.
 - 2. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 - 1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
 - 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 - 3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
 - 5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
 - 6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.
 - a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.
- C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

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- D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within one week of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- E. 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.
- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
- G. Concrete paving will be considered defective if it does not pass tests and inspections.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.10 REPAIRS AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective, or does not meet the requirements of this Section.
- B. Drill test cores where directed by Architect when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to paving with epoxy adhesive.
- C. Protect concrete from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep concrete paving not more than 2 days prior to date scheduled for Substantial Completion inspections.
- E. Remove and replace concrete paving or curb and gutter that ponds water.

END OF SECTION 321313

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SECTION 323113 – PARKING GATE

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. Parking Control Barrier Arm and Operator
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 31, Section "Earth Moving" for filling and grading work.
 - 2. Division 03, Section "Cast-in-Place Concrete" for concrete for post footings.

1.3 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 01 Specification Sections.
- B. Product data in the form of manufacturer's technical data, specifications, and installation instructions for gate arms, barrier operator, controls and accessories.
- C. Manufacturer warranty information.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has at least three years' experience and has completed at least five barrier gate projects with same material and of similar scope to that indicated for this Project with a successful construction record of in-service performance.
- B. Single-Source Responsibility: Obtain gate arm barrier system including accessories, fittings, and fastenings, from a single source.
- C. Provide manufacturer's standard limited warranty covering gate and operator against failure resulting from normal use for period of 5 years from date of purchase. Failure is defined as any defect in manufacturing that prevents the gate from operating in a normal manner.
- D. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the International Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

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1. Testing Agency's Field Supervisor: Person currently certified according to NETA ETT, or the National Institute for Certification in Engineering Technologies, to supervise on-site testing specified in Part 3.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify layout information for fences and gates shown on the Drawings in relation to the property survey and existing structures. Verify dimensions by field measurements.

PART 2 - PRODUCTS

2.1 PARKING CONTROL BARRIER ARM AND OPERATOR

1. Basis of Design: Parking Control Barrier Gate and Operator, Model #1602 by DoorKing or approved equal.
2. Enclosure: NEMA 4X weather resistant enclosure
3. Barrier Arm:
 - a. Length: 20-feet
 - b. Material: Rectangular Wood Wishbone Arm
 - c. Breakaway feature for impact protection
4. Control system
 - a. Loop Detector inputs for safety and free-exit operation
 - b. Communication for integration with access control systems
 - c. 120V system
5. Safety Features
 - a. Reversing feature upon contact with an obstruction
 - b. Pedestrian Protection System
 - c. LED indicators for operational status

PART 3 - EXECUTION

3.1 INSPECTION

PARKING GATE

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- A. Verify that gate grading in fence location is completed and without irregularities which will interfere with fence installation. Variations in height, slopes, stairs, stepping shall be shown on contract drawings and on submittal drawings.
- B. Field verify all gate dimensions and layout prior to commencing installation.
- C. Do not commence work until unsatisfactory conditions have been corrected.

3.2 GATE INSTALLATION

- A. Install gates plumb, level, and secure for full opening without interference. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary. Install gates according to manufacturer's instructions, plumb, level, and secure.

3.3 GATE ADJUSTING

- A. Gate: Adjust gate to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

3.4 GATE DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's personnel to adjust, operate, and maintain gates. Additionally, demonstrate the general maintenance of the gate operator and accessories and provide copy of the manufacturer's installation, operation and maintenance manuals for the owner. Manuals shall identify parts of the equipment for future procurement.

END OF SECTION 323113

SECTION 323113.53 – HIGH-SECURITY CHAIN-LINK FENCES AND GATES

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Security chain-link fences.
 - 2. Security Gates:
 - a. Manual operation swing.
 - b. Horizontal sliding motor operation.
 - 3. Fence accessories.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated-Design Submittal: For chain-link fences, fence cap panels, and gate framework indicated to comply with performance requirements and design criteria, including structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation and is registered in the state where the project occurs.
- B. Structural Performance: Provide chain-link fences and gates capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Line Post Design: Provide line posts of size indicated but not less than sizes required to comply with ASTM F1043 with post spacing not to exceed 10 feet in resisting the following wind-load criteria, based on fence height, mesh size, and pattern indicated:
 - a. Design Wind Loads: Determine design wind loads applicable to Project from basic wind speed and exposure category indicated on the Structural Drawings and according to ASCE 7-16, as referenced in 2021 IBC.
 - b. Fence Framework Material Group: Provide either IA, ASTM F 1043, Schedule 40 steel pipe or IC, electric-resistance-welded round steel pipe.
 - 2. Fabric Tension: Provide fences in which fabric deflections do not exceed 2.5 inches (64 mm) when tested by applying a 30-lbf (133-N) force at midpoint between rails and horizontally between posts for every eighth lower panel along the fence line.
 - 3. Fence Post Rigidity: Provide fences in which post deflections do not exceed 3/4 inch (19 mm) when tested by applying a 50-lbf (222-N) force at mid-height of every eighth post along the fence line.
- C. Lightning Protection System: Maximum grounding-resistance value of 25 ohms under normal dry conditions.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review required testing, inspecting, and including certifying procedures for fencing and grounding.
 - 2. Inspect and discuss electrical roughing-in, equipment bases, and other preparatory work specified elsewhere.
 - 3. Review gate operator interface with security control system.
 - 4. Review sequence of operation for each type of gate operator.

5. Review coordination of interlocked equipment specified in this Section and elsewhere.

1.5 ACTION SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for chain-link fences and gates:
 1. Fence and gate posts, rails, and fittings.
 2. Chain-link fabric, reinforcements, and attachments.
 3. Gates and hardware.
 4. Gate operator, including operating instructions and motor characteristics.
 5. Accessories:
 - a. Barbed wire.
 - b. Barbed tape.
- B. Shop Drawings:
 1. Show locations of fences, gates, posts, rails, tension wires, details of extended posts, extension arms, gate swing, or other operation, hardware, and accessories.
 2. Indicate materials, dimensions, sizes, weights, and finishes of components.
 3. Include plans, gate elevations, sections, details of post anchorage, attachment, bracing, and other required installation and operational clearances.
 4. Gate Operator: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
 5. Wiring Diagrams: Power and control wiring.
 - a. Gates are controlled remotely from touchscreen. Review interface requirements and operational sequences with Division 28 Security Control System Subcontractor (SCSC), Architect, and Owner.
- C. Delegated-Design Submittal: Refer to 1.3.A. and 1.3.B under "Performance Requirements" above.

1.6 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of chain-link fence and gate, signed by product manufacturer.
 1. Strength test results for framing according to ASTM F 1043.
- B. Qualification Data: For Installer.
- C. Warranty: Sample of special warranty.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed chain-link fences and gates similar in material, design, and extent to those indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Administrative Requirements" and 1.4.A above.

1.8 PROJECT CONDITIONS

- A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of security chain-link fences and gates that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure to comply with performance requirements.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 2. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CHAIN-LINK FENCE FABRIC

- A. Chain-Link Fence Fabric: Provide fabric in one-piece heights, measured between top and bottom of outer edge of selvage. Comply with ASTM A 392, CLFMI CLFS 2445, and with requirements indicated below:
 - 1. Steel Wire Fabric: Metallic coated.
 - 2. Fabric, 12 feet and as otherwise indicated on the Drawings.
 - a. Wire Diameter:
 - 1) 9 gage minimum, unless indicated otherwise.
 - b. Mesh Size: 2 inch and 1/2 inch.
 - c. Weight of Metallic (Zinc) Coating: ASTM A 392, Type II, Class 2, 2.0 oz/sq. ft. (610 g/sq. m) with zinc coating applied before or after weaving.
 - d. Coat selvage ends of fabric that is metallic coated before the weaving process with manufacturer's standard clear protective coating.
 - 3. Selvage: Twisted and barbed top and bottom.

2.2 SECURITY FENCE FRAMEWORK

- A. Posts and Rails: Comply with ASTM F 1043 for framing of the following material group and strength requirement for fences of height indicated:
 - 1. Framework Material Group: IA, round steel pipe, Schedule 40 or IC, round steel pipe with a yield strength of 50,000 psi (345 MPa).
 - 2. Fence Height: As indicated on the Drawings.
 - 3. Strength Requirement: Heavy industrial fence according to ASTM F 1043.
 - 4. Post Diameter and Thickness (for Standard and Security Fence): Provide posts of minimum sizes indicated below that comply with ASTM F 1083.
 - a. Line Post: 4 inches.
 - b. End, Corner, and Pull Post: 4 inches.
 - c. Swing Gate Post: According to ASTM F 900.

5. Post Diameter and Thickness (for fence cap panels): Provide posts of minimum sizes indicated below that comply with ASTM F 1083.
 - a. Top Rail: 1.66 inches.
 - b. Line Post: 2.375 inches.
 - c. End, Corner and Pull Post: 2.875 inches.
 6. Metallic Coating for Steel Framing:
 - a. External, Type B, zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. (0.27 kg/sq. m) of zinc after welding, a chromate conversion coating, and a clear, verifiable polymer film. Internal, Type D, consisting of 81 percent, not less than 0.3-mil- (0.0076-mm-) thick, zinc pigmented coating.
- B. Top Rails: Fabricate top rail from lengths 21 feet or longer, with swaged-end or fabricated for expansion-type coupling, forming a continuous rail along top of chain-link fabric, 1.660 inch OD minimum.
- C. Intermediate Rails: Match top rail for size, coating and strength and stiffness requirements.
- D. Bottom Rails: Match top rail for size, coating and strength and stiffness requirements.
- 2.3 TENSION WIRE
- A. General: Provide horizontal tension wire at the following locations:
1. Location: As indicated.
- B. Metallic-Coated Steel Wire: 0.177-inch- (4.5-mm-) diameter, marcelled tension wire complying with ASTM A 824 and the following:
1. Metallic Coating: Type I, aluminum coated (aluminized), with the following minimum coating weight:
 - a. Class 3: Not less than 2.0 oz./sq. ft. (610 g/sq. m) of uncoated wire surface.
- 2.4 SWING GATES
- A. TyMetal Corporation's 2150 Pedestrian Swing Gate System is an acceptable alternative to shop-fabricated gates as specified in 2.4.B through 2.4.D below. Gates shall be provided fully factory-assembled and shipped to the project site ready for installation.
- B. General: Comply with ASTM F 900 for single and double swing gate types, as indicated.
1. Metal Pipe and Tubing: Galvanized steel. Comply with ASTM F 1043 and ASTM F 1083 for materials and protective coatings.
- C. Frames and Bracing: Fabricate members from round, galvanized steel tubing with outside dimension and weight according to ASTM F 900 and the following:
1. Gate Fabric Height: 2 inches (51 mm) less than adjacent fence height.
 2. Gate Leaf Width: As indicated.
 3. Frame Members:
 - a. Tubing Size: 1.90 inches (48 mm) round, minimum.
 4. Provide custom fabrications including mounting plates and housings to receive security detention locks, gate position switch, and other devices provided by Division 11 Detention Equipment Contractor (DEC) and Division 28 Security Control System Contractor (SCSC). Coordinate closely with (DEC & SCSC) supplier of such equipment and devices; obtain templates (if required) and confirm dimensional requirements prior to fabrication.

- D. Frame Corner Construction:
 - 1. Welded and 3/8-inch- (9.5-mm-) diameter, adjustable truss rods for panels 5 feet (1.52 m) wide or wider.
- E. Extended Gate Posts and Frame Members: Extend gate posts and frame end members above top of chain-link fabric at both ends of gate frame 12 inches (305 mm), or as indicated, as required to attach barbed wire assemblies.
- F. Hardware:
 - 1. Hinges for gates not indicated to receive security detention locks: Offset type, galvanized malleable iron, 180-degree swing.
 - 2. Hinges for gates with security detention locks: Provide self-closing hinge(s) at gates.
 - 3. Latches for gates not indicated to receive security detention locks: Provide latches permitting operation from both sides of gate. Fabricate latches with integral eye openings for padlocking; padlock accessible from both sides of gate.
 - 4. Lock Housings and Brackets for security detention locks: Provide galvanized custom fabrications indicated to receive locks and security devices specified in Division 11 Section "Security Hardware" and Division 28 Section "Security Control System."

2.5 HORIZONTAL-SLIDE GATES

- A. General: ASTM F 1184 for gate posts and single sliding gate types:
 - 1. Classification: Type I Overhead Slide.
 - 2. Basis-of-Design: Tymetal Corp.; PLUSS Sliding Gate System or approved equivalent meeting or exceeding basis-of-design product. Ground-mounted operators, exposed chain or rails are not acceptable.
 - a. Gate frame: Fully welded construction, 2-3/8" O.D. galvanized steel pipe, black polymer-coated, with galvanized steel bottom angle.
 - b. Operation: Fully automatic by remote electronic control from designated security control station with a fully-enclosed drive assembly.
 - c. Post-mounted motor box with emergency hand crank and paracentric prison lock.
 - d. Drive assembly shall be as recommended by the manufacturer to suit project conditions.
 - e. Keyless three-point locking.
 - f. Coordinate with requirements of Division 28 for interface with security control system.
- B. Overhead Track Assembly: Manufacturer's standard track, with overhead framework supports, bracing, rollers, and accessories, engineered to support size, weight, width, operation, and design of gate and roller assemblies.
- C. Hardware:
 - 1. Hangers, Roller Assemblies, Stops, Bottom Guides: Manufacturer's standard hardware and components.
 - 2. Lock: Manufacturer's standard internal device, complete with lock cam assembly, locking column, lock bar, lock bar guides, and cover.

2.6 FITTINGS

- A. General: Comply with ASTM F 626.

- B. Post and Line Caps: Each post.
 - 1. Line post caps with loop to receive tension wire or top rail.
 - C. Rail and Brace Ends: Attach rails securely to each gate, corner, pull, and end post.
 - D. Rail Fittings: Provide the following:
 - 1. Top-Rail Sleeves: Pressed steel or round steel tubing not less than 6 inches (152 mm) long.
 - 2. Rail Clamps: Line and corner boulevard clamps for connecting intermediate and bottom rails in the fence line to line posts.
 - 3. Provide off-set type devices as required to secure top, intermediate, and bottom rails at "oversize" post conditions, such that face of rails and post are in plane and chain-link fabric may be installed without distortion.
 - E. Tension and Brace Bands: Pressed steel, 0.105 inch (2.66 mm) thick, with 1.2-oz/sq. ft. (366-g/sq. m) metallic (zinc) coating.
 - F. Tension Bars: Steel, length not less than 2 inches (51 mm) shorter than full height of chain-link fabric with 1.2-oz/sq. ft. (366-g/sq. m) metallic (zinc) coating. Provide one bar for each gate and end post, and two for each corner and pull post unless fabric is integrally woven into post.
 - G. Truss Rod Assemblies: Steel, hot-dip galvanized after threading rod and turnbuckle or other means of adjustment.
 - H. Barbed Wire Arms: Pressed steel or cast iron, with clips, slots, or other means for attaching strands of barbed wire, integral with post cap; for each post, unless otherwise indicated, and as follows:
 - 1. Line posts with arms designed with opening to accommodate top rail.
 - 2. Arms shall accommodate three (3) strands of barbed wire and double coil of barbed tape, as indicated.
 - 3. Corner arms at fence corner posts, unless extended posts are indicated.
 - 4. Type I, single slanted arm, unless indicated otherwise.
 - 5. Bolts or rivets for connection to post.
 - I. Tie Wires, Clips, and Fasteners: According to ASTM F 626.
 - 1. High-Security Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, complying with the following:
 - a. Metallic-Coated Steel: 0.192-inch- (4.88-mm-) diameter wire.
 - b. Weight of Aluminum Coating: ASTM A 809, 0.4 oz/sq. ft. (122 g/sq. m).
 - J. Power-Driven Fabric Fasteners: Type 304, 0.0938-inch- (2.38-mm-) thick, specially designed cap to anchor fabric to framing with a power-driven, heat-treated, knurled pin.
 - K. Finish:
 - 1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz. /sq. ft. (366 g /sq. m) of zinc.
- 2.7 BARBED WIRE
- A. Zinc-Coated Steel Barbed Wire: Comply with ASTM A 121, Design Number 12-4-5-14R for the following 2-strand barbed wire:

1. Standard Size and Construction: 0.099-inch- (2.51-mm-) diameter line wire with 0.080-inch- (2.03-mm-) diameter, 4-point round barbs spaced not more than 5 inches (127 mm) o.c.
2. Metallic Coating for Barbed Wire: ASTM A 121 Class 3, not less than 0.80 oz/sq. ft. (245 g /sq. m) of zinc.

2.8 BARBED TAPE

- A. Wire-Reinforced Tape (Razor Ribbon): ASTM F 1910; continuous coils with four-point, needle-sharp barbs permanently cold clenched around a core wire.
 1. Core Wire: High-tensile-strength, zinc-coated steel, or stainless steel.
 2. Configuration: Double coil.
 3. Style: Concertina pattern.
 4. Coil Diameter(s): 24 inches inner coil and 30-inch outer coil.
 5. Coil Loop Spacing(s): 12 inches.
 6. Barb Length Classification: Medium, 0.4-inch
 7. Barb Spacing: 4 inches o.c.
 8. Barb Set: Manufacturer's standard.
- B. Clips: Stainless steel, 0.065 inch (1.7 mm) thick by 0.375 inch (9.5 mm) wide, capable of withstanding a minimum 150-lbf (667-N) pull load to limit extension of coil, resulting in a concertina pattern when deployed.
- C. Tie Wires: Stainless steel, 0.065 inch (1.7 mm) in diameter.

2.9 CAST-IN-PLACE CONCRETE

- A. Materials: Portland cement complying with ASTM C 150, Type I, aggregates complying with ASTM C 33, and potable water for ready-mixed concrete complying with ASTM C 94/ C 94M.
 1. Concrete Mixes: Normal-weight concrete, air entrained, with not less than 3000-psi (20.7-MPa) compressive strength (28 days), 3-inch (75-mm) slump, and 1-inch (25.4-mm) maximum size aggregate.
- B. Materials: Dry-packaged concrete mix complying with ASTM C 387 for normal-weight concrete mixed with potable water according to manufacturer's written instructions.

2.10 GROUT AND ANCHORING CEMENT

- A. Non-shrink, Nonmetallic Grout: Premixed, factory-packaged, non-staining, non-corrosive, nongaseous grout complying with ASTM C 1107. Provide grout, recommended in writing by manufacturer, for exterior applications.
- B. Erosion-Resistant Anchoring Cement: Factory-packaged, non-shrink, non-staining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating, and that is recommended in writing by manufacturer for exterior applications.

2.11 FENCE GROUNDING

- A. Conductors: Bare, solid wire for No. 6 AWG and smaller; stranded wire for No. 4 AWG and larger.

1. Material above Finished Grade: Copper or Aluminum.
 2. Material on or below Finished Grade: Copper.
 3. Bonding Jumpers: Braided copper tape, 1 inch (25.4 mm) wide, woven of No. 30 AWG bare copper wire, terminated with copper ferrules.
- B. Connectors and Grounding Rods: Listed in UL 467.
1. Connectors for Below-Grade Use: Exothermic welded type.
 2. Grounding Rods: Copper-clad steel.
 - a. Size: 5/8 inch by 96 inches (16 mm by 2440 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, and other conditions affecting performance.
1. Do not begin installation before final grading is completed, unless otherwise permitted by Architect.
 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet (152 m) or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.
- B. Coordinate post locations with all underground utilities and structures, and building foundation systems.

3.3 INSTALLATION, GENERAL

- A. Install chain-link fencing to comply with ASTM F 567 and more stringent requirements specified.

3.4 CHAIN-LINK FENCE INSTALLATION

- A. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.
- B. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.
1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
 2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
 - a. Exposed Concrete: Extend 2 inches (51 mm) above grade or to same elevation as concrete grade beam; shape and smooth to shed water, unless indicated otherwise.
 - b. Concealed Concrete: Top 4 inches (102 mm) below grade, or as indicated on Drawings, to allow covering with surface material. Provide at concrete "mow strip" as indicated; not required at paving areas.

- C. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment of as indicated on the Drawings.
- D. Line Posts: Space line posts uniformly at 10 feet (3 m) o.c.
- E. Post Bracing and Intermediate Rails: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Install braces at end and gate posts and at both sides of corner and pull posts.
 - 1. Locate horizontal braces at mid-height of fabric 6 feet (1.8 m) or higher, on fences with top rail and at 2/3 fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.
- F. Barbed Wire Arms: Bolt or rivet to top of post. Angle single arms away from approach side of fence, unless otherwise indicated.
- G. Tension Wire: As required, install according to ASTM F 567, maintaining plumb position and alignment of fencing. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch- (3.05-mm-) diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches (610 mm) o.c. Install tension wires in locations indicated before stretching fabric.
- H. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended by fencing manufacturer.
- I. Bottom Rails: Install bottom rails spanning between posts. Anchor rail at mid-span to concrete "mow strip" as detailed on the Drawings.
- J. Chain-Link Fabric: Apply fabric to secure side of enclosing framework. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.
 - 1. Leave 2 inches between finish grade or surface and bottom selvage, unless otherwise indicated.
 - 2. Overlapping Fabric: At or between post or rail, overlap 6 inches and secure with wire ties or steel strap method.
- K. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not more than 15 inches o.c.
- L. Tie Wires: Power-fastened or manually fastened ties configured to wrap a full 360 degrees around rail or post and a minimum of 1 complete diamond of fabric. Twist ends one and one-half machine twists or three full manual twists, and cut-off protruding ends to preclude untwisting by hand.
 - 1. Maximum Spacing: Tie fabric to line posts at 12 inches o.c. and to rails and braces at 24 inches o.c.
- M. Power-Driven Fasteners: Fasten 0.192- or 0.148-inch wire fabric with 2- or 1-inch mesh size.
 - 1. Fasten fabric to line posts 12 inches o.c. and to braces 24 inches o.c.
- N. Fasteners: Install nuts for tension bands and carriage bolts on the side of fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.
- O. Barbed Wire: Install barbed wire uniformly spaced as indicated on the Drawings. Pull wire taut and install securely to extension arms and secure to end post or terminal arms.

- P. Barbed Tape: Install according to ASTM F 1911. Install barbed tape uniformly in configurations indicated and fasten securely to prevent movement or displacement.

3.5 GATE INSTALLATION

- A. Install gates according to manufacturer's printed instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.6 GROUNDING AND BONDING

- A. Comply with requirements in Division 26 Section "Grounding and Bonding."
- B. Fence Grounding: Install at maximum intervals of 100 feet except as follows:
 - 1. Gates and Other Fence Openings: Ground fence on each side of opening.
 - a. Bond metal gates to gate posts.
 - b. Bond across openings, with and without gates, except openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches below finished grade.
- C. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location, including the following:
 - 1. Each Barbed Wire Strand. Make grounding connections to barbed wire with wire-to-wire connectors designed for this purpose.
- D. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.
- E. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 - 4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- F. Bonding to Lightning Protection System: If fence terminates at lightning-protected building or structure, ground the fence, and bond the fence grounding conductor to lightning protection down conductor or lightning protection grounding conductor complying with NFPA 780.

3.7 FIELD QUALITY CONTROL

- A. Grounding-Resistance Testing: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
 - 1. Grounding-Resistance Tests: Subject completed grounding system to a megger test at each grounding location. Measure grounding resistance not less than two full days after

last trace of precipitation, without soil having been moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural grounding resistance. Perform tests by two-point method according to IEEE 81.

2. Excessive Grounding Resistance: If resistance to grounding exceeds specified value, notify Architect promptly. Include recommendations for reducing grounding resistance and a proposal to accomplish recommended work.
3. Report: Prepare test reports, certified by testing agency, of grounding resistance at each test location. Include observations of weather and other phenomena that may affect test results.

3.8 ADJUSTING

- A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Horizontal Sliding Gate Operator: Energize circuits to electrical equipment and devices, start units, and verify proper motor rotation and unit operation.
 1. Test and adjust operator, controls, and safety devices. Replace damaged and malfunctioning controls and equipment.
 2. Lubricate operator and related components.
- C. Lubricate hardware and other moving parts.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's personnel to adjust, operate, and maintain gates. Refer to Division 01 Section "Closeout Procedures."

END OF SECTION 323113.53